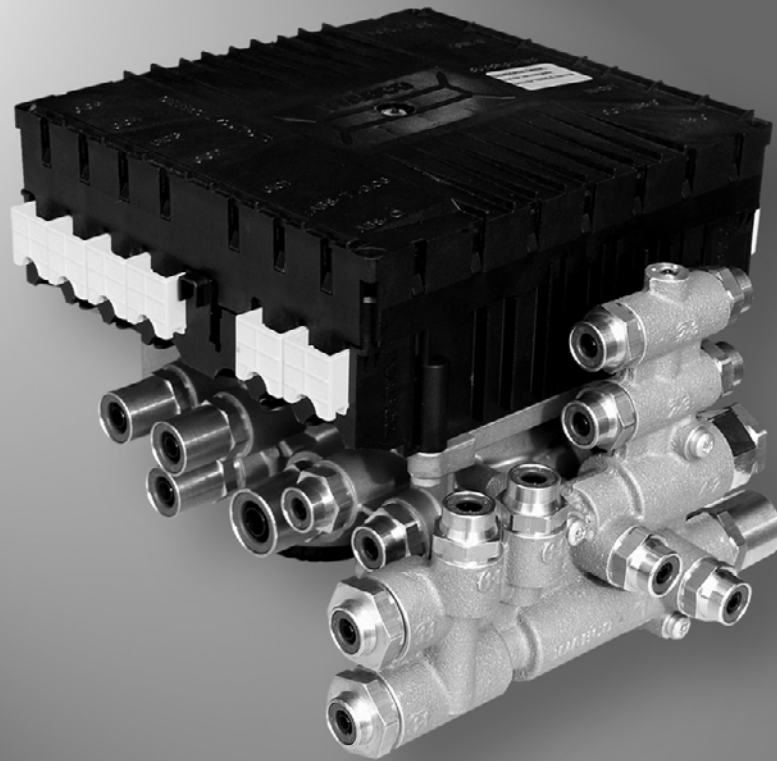


# TEBS E2

## Electronic Braking System for Trailers



# WABCO



# TEBS E2

## **Electronic Braking System for Trailers**

### System Description

Edition 4

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**WABCO**

## Abbreviations

24N	Brake light supply
4S/3M	4 sensors / 3 modulators
ABS	Anti-Lock Braking System
ADR	(French Accord européen relatif au transport international des marchandises Dangereuses par Route); European agreement concerning the carriage of dangerous goods by road
BO	German Ordinance Regulating Passenger Transport
BVA	(German: Bremsbelagverschleißanzeige); Brake pad wear indicator
CAN	Controller Area Network; asynchronous, serial bus system for networking control devices in vehicles
EBS	Electronic Braking System
ECAS	Electronically Controlled Air Suspension
ELEX	Electronic Extension Module
GGVS	(German: Gefahrgutverordnung Straße); Act governing the road haulage of hazardous goods
GIO	Generic Input/Output
IR	Individual control; individual control of sensed wheels on one side.
ISS	Integrated Speed Switch
LACV-IC	Lift Axle Control Valve, impulse controlled
LIN	Local Interconnect Network; Interface of ultrasonic sensor, bus system; distance information is transferred as data. Since this a bus, several sensors can be located on the same line.
LSV	Automatic load-dependent brake force control (load sensing valve)
MAR	(German: Modifizierte Achs-Regelung); Modified axle control; Control of two sensed wheels on one axle.
MSR	(German: Modifizierte Seiten-Regelung); Modified side control; Control of two sensed wheels on one vehicle side.
ODR	Operating Data Recorder
PEM	Pneumatic Extension Module
PLC	Power Line Communication; Data communication via cable for power supply
PWM	Pulse Width Modulation; Interface of the ultrasonic sensor; the transferred distance information is time-discrete, the level of the signal line changes suddenly if the sensor receives an echo. Every sensor requires its own signal line.
RSS	Roll Stability Support (for trailers)
SHV	Select High Valve; Valve for providing the higher pressure
SLV	Select Low Valve; Valve for providing the lower pressure
StVZO	(German: Straßenverkehrs-Zulassungs-Ordnung); German motor vehicle construction and use regulations
TASC	Trailer Air Suspension Control
TCE	Trailer Central Electronics
TEBS	Electronic Braking System for Trailers
TRC	Trailer Remote Control
TT	Timer Ticks
USB	Universal Serial Bus; serial bus system for connecting a computer to external devices

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## 1 Instructions and safety instructions

### 1.1 Symbols used

**DANGER**


Imminent hazard situation which can cause serious personal injury or death if the safety instruction is not observed.

**WARNING**


Potential hazard situation which can cause death or serious personal injury if the safety instruction is not observed.

**CAUTION**


Potential hazard situations that can cause minor or moderate personal injury if the safety instruction is not observed.



Important instructions, information, or tips that you should always observe.



Reference to information, publications etc. on the Internet

**TEBS E1**

As of Trailer EBS E1 (since September 2008)

**TEBS E1.5**

As of Trailer EBS E1.5 (since December 2009)

**TEBS E2**

As of Trailer EBS E2 (since November 2010)

- List
- Step
- ➔ Consequence of an action

### 1.2 Avoiding electro-static charge and uncontrolled discharging (ESD)

#### Note during construction and building the vehicle:

- Prevent potential differences between components (e. g. axles) and the vehicle frame (Chassis).  
Make sure that the resistance between metallic parts of the components to the vehicle frame is lower than 10 Ohm (< 10 Ohm).  
Connect moving or insulated vehicle parts such as axles electrically conductive with the frame.
- Prevent potential differences between the towing vehicle and the trailer.  
Make sure that an electrically conductive connection is made via the coupling (king pin, fifth wheel, claws with pins), even with no cable connection.

- Use electrically conductive bolted connections when fastening the ECUs to the vehicle frame.
- Use only cable conforming to WABCO specifications or WABCO original cable.
- Run the cable in metallic casing if at all possible (e. g. inside the U-beam) or behind metallic and grounded protective plating, to minimise the influence of electro-magnetic fields.
- Avoid the use of plastic materials if they can cause electrostatic charging.

**Note during repair and welding work on the vehicle:**

- Disconnect the battery – if installed in the vehicle.
- Disconnect cable connections to devices and components and protect the plug-ins and connections from contamination and humidity.
- Always connect the grounding electrode directly with the metal next to the welding position when welding, to prevent magnetic fields and current flow via the cable or components.  
Make sure that current is well conducted by removing paint or rust.
- Prevent heat influences on devices and cabling when welding.

### 1.3 Information and Disclaimer



Read the information in this document carefully. Note especially the information on your safety.

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We assume no liability for the correctness, completeness or actuality of the information in this document. All technical information, descriptions and images are applicable for the day of printing this document or respective supplements. We retain the right to any changes as a result of continuous further development.

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## 1.4 Safety instructions

- Read this publication thoroughly. Adhere to all instructions, information and safety information to prevent injury to persons and damage to property. WABCO will only guarantee the security, reliability and performance of their products and systems if all information in this publication is adhered to.
- Make sure to follow the specifications and instructions of the vehicle manufacturer.
- Maintain all accident regulations of the business as well as regional and national regulations.

Only trained and qualified technicians are to perform any work on the vehicle.

Your workspace must be dry as well as sufficiently illuminated and ventilated.

### **Risk of injury!**

- Pedal actuations can lead to severe injuries if persons are in the vicinity of the vehicle.

Make sure that pedals cannot be actuated as follows:

- Switch the transmission to "neutral" and actuate the hand brake.
- Secure the vehicle against rolling with chocks.
- Fasten a visible note to the steering wheel indicating the work is being performed on the vehicle and that the pedals are not to be actuated.
- Do not wear a tie, loose clothing, open hair, arm bands, etc. when working on the vehicle, especially with the engine running. Keep your hands and hair away from the moving parts.

### **Fire hazard!**

- Use only ground lights.
- Keep flammable material (cloths, paper, etc.) away from the exhaust system.
- Do not smoke in the workplace.
- Check electrical lines for proper insulation and fastening.

## 2 Introduction

This document is meant for the manufacturer of trailer vehicles and workshops.

Since the Trailer EBS E is a very complex system, this system description is extensive. Here are a couple of notes on the structure of the document:

### **Braking system**

Here, you find a description of the functions that are required to meet legal guidelines, such as the ABS, RSS and other functions of the braking control.

### **GIO functions**

Besides the control of wheel brakes, the Trailer EBS E Premium variant has a number of functions that can be created specific to the respective vehicle. Besides the solutions "prepared" by WABCO, such as the control of air suspension systems or the dynamic wheelbase control, the methods for implementing third-party controllers that can be configured is also explained.

### **External systems**

External systems can be connected to the Trailer EBS E modulator. Information on the following systems can be found in this chapter: Electronic expansion module ELEX (including descriptions on possible additional functions), Trailer Remote Control, IVTM (tyre pressure monitoring), external ECAS, TCE (Trailer Central Electronics) and Telematics.

### **Installation notes for vehicle installation and retrofitting**

This chapter contains descriptions on how individual components and cables are installed and mounted.

### **System start-up**

Besides start-up and calibration, extensive information is also provided on parameter definition and setting with the TEBS E Diagnostic Software.

### **Operation**

This chapter goes into depth on the operation.

### **Workshop instructions**

The workshop information includes mainly notes on maintenance, system diagnostics, troubleshooting, fine tuning and on replacing components.

### **Appendix**

The appendix contains diagrams and overviews.

## Further information



Technical documents, posters and forms can be obtained via the Internet at <http://www.wabco-auto.com/> by entering an index work or the document number in the online product catalogue INFORM.

Documents, posters, forms	Index word
SmartBoard – System description SmartBoard – Operating Instructions	SmartBoard
CAN-Router / CAN-Repeater – System description	CAN Router
ODR tracker – Operating manual	ODR
External ECAS for towing vehicle – System description	ECAS
Couplings catalogue	Fitting
IVTM system description	IVTM
General Repair and Test Information	Repair manual
Replacing the TEBS E modulator	TEBS E
Diagnostic – Software/Hardware	Diagnosis
Telematics (TrailerGUARD) – System description	Telematic
Poster "TEBS E – Connecting cable"	TEBS E
Poster "TEBS E – System overview"	TEBS E
Form "Technical vehicle data for the brake calculation for trailers"	Brake calculation

## 2.1 System design

This chapter provides you with a general overview of function and structure of the basic systems.

### 2.1.1 Brake system

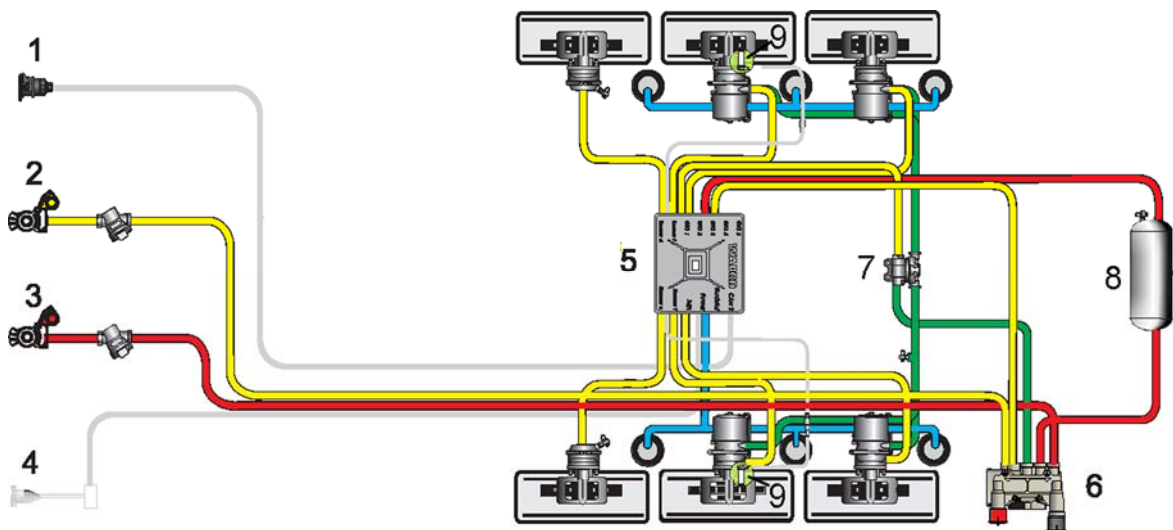
#### Components of the TEBS E brake system for the semitrailer (without PEM)

- Park-release emergency valve (PREV)
- Electro-pneumatic control unit with integrated electronic controller (TEBS E modulator with integrated pressure sensors and integrated backup valve)
- Cabling and pipework of the components.

#### Semitrailer example

Depending on the number of ABS rotational-speed sensors, this configuration is referred to as a 2S/2M or 4S/2M system for typical semitrailers.

Semitrailer 2S/2M

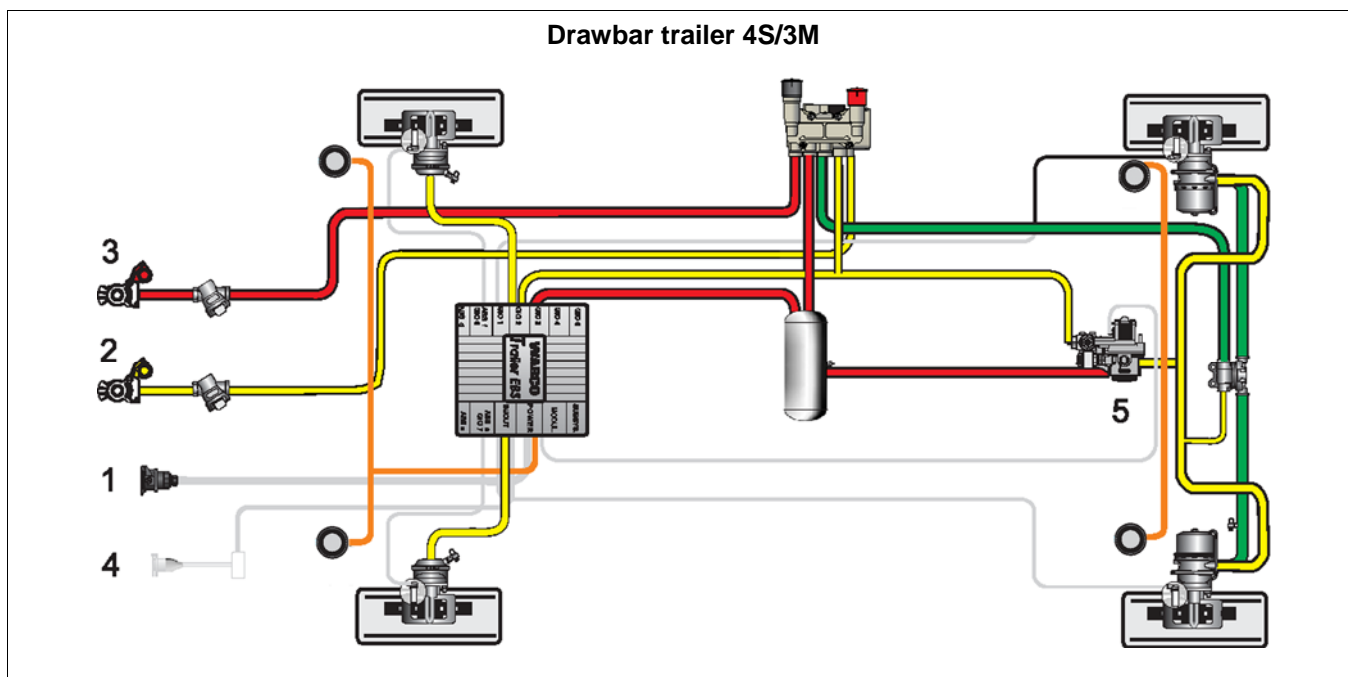


#### Legend

1 Voltage supply via ISO 7638	2 Control line	3 Supply line
4 Stop light supply 24N via ISO 1185 (optional)	5 TEBS E Modulator	6 PREV
7 Overload protection valve	8 Service brake system reservoir	9 ABS rotational-speed sensor

**Drawbar trailer example**

This configuration is named the 4S/3M system for the typical drawbar trailer.

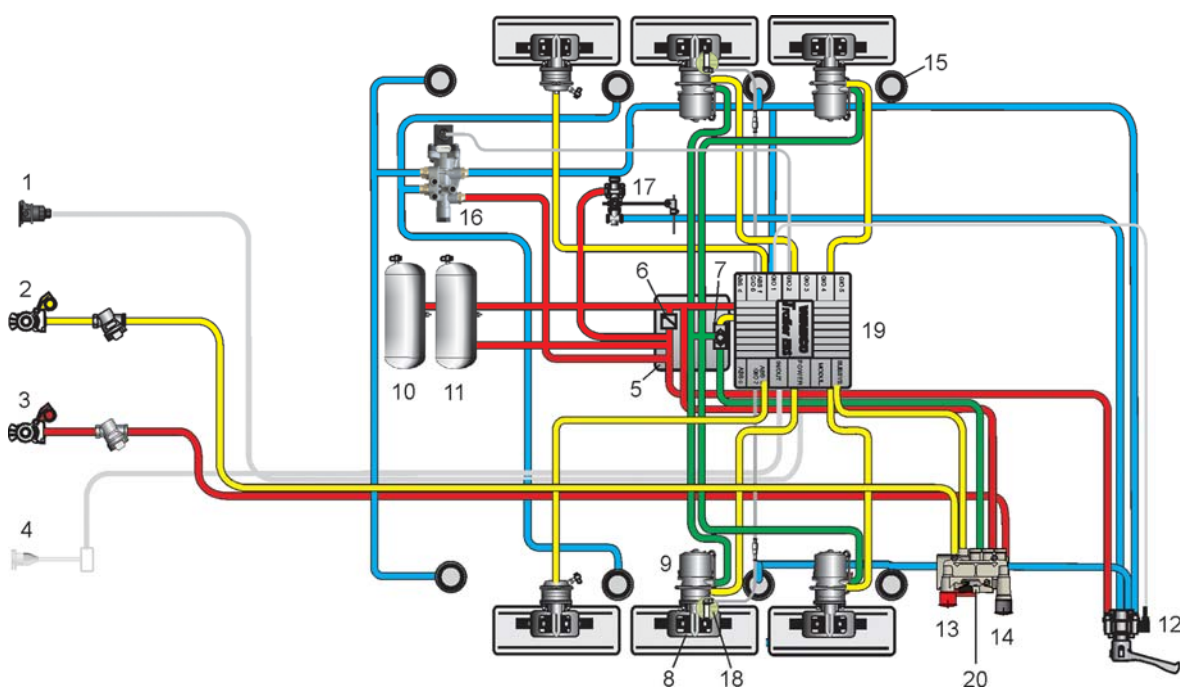
**Legend**

- |   |  |               |
|---|--|---------------|
| 1 Voltage supply via ISO 7638                   | 2 Control line   | 3 Supply line |
| 4 Stop light supply 24N via ISO 1185 (optional) | 5 EBS relay valve for controlling the 2nd axle (3rd modulator) |               |

### 2.1.2 Description of the trailer braking system with conventional air suspension

With the introduction of the new Trailer EBS E braking system the tubing and cabling of the trailer braking and air suspension system has been simplified considerably.

**Trailer braking system with conventional air suspension**



#### Legend

1 Voltage supply via ISO 7638	2 Control line	3 Supply line
4 Stop light supply 24N via ISO 1185 (optional)	5 Pneumatic Extension Module (PEM)	6 Charging valve (integrated in the PEM)
7 Overload protection valve (integrated in the PEM)	8 Service brake part of the Tristop® cylinders	9 Tristop® cylinder
10 Service brake system reservoir	11 Reservoir for the air suspension	12 Lift-/Lower valve (e.g. TASC)
13 Red button for actuating the parking brake system (on PREV)	14 Black button for releasing the automatic brake (on PREV)	15 Support bellows
16 Lifting axle valve	17 Levelling valve	18 ABS rotational-speed sensor
19 TEBS E Modulator	20 Park-release emergency valve (PREV)	



## Trailer brake system

The trailer vehicle is connected to the towing vehicle via two hose couplings for supply pressure (3) and control pressure (2). The parking release emergency valve (PREV, 20) is used to conduct the control pressure to the TEBS E (19). The PREV is equipped with a red button (13) for actuating the parking brake, as well as a further black actuating button (14) for releasing the brake which is automatically actuated when the trailer vehicle is unhitched. The compressed air of the reservoir flows to the Pneumatic Extension Module (PEM, 5) via a check valve integrated in the PREV.

The PEM includes the following functions:

- a charging valve for securing pressure in the air brake system apart from the air suspension,
- an overload protection valve to protect the wheel brakes from overloading – when service and parking brake are actuated simultaneously,
- a pressure distribution for the supply "air suspension" and supply "service brake".

The TEBS E Modulator controls the service brake components (8) of the Tristop® cylinders (9). At least two rotational-speed sensors (18) ABS are connected for sensing the wheel speeds. A pressure test connection is also provided on the PEM for measuring the current braking pressure. The PEM charges the service brake system reservoir (10) with the supply pressure from the PREV.

The same line is used to supply the TEBS E Modulator with supply pressure from the reservoir. The reservoir for the air suspension system (11) is charged via the charging valve integrated in the PEM. The charging valve has the task to ensure that primary pressure is maintained in the "Brake" reservoir and thus the ability of the towing vehicle to brake, in the event of a pressure drop in the air suspension system. In order to protect the wheel brakes from overloading from the additional brake force (diaphragm part and spring chamber of the Tristop® cylinder actuated simultaneously), an overload valve (7) is integrated in the PEM. The pressure is distributed to the Tristop® cylinders (9) by the PEM.

The parking brake is actuated by pressing the red button on PREV (13). This exhausts the parking brake component of the Tristop® cylinder so that the integrated spring can actuate the wheel brake. If the service brake is also used while the parking brake is actuated, the braking pressure flows into the parking brake component of the Tristop® cylinders via the overload protection valve, thereby relieving the force in the parking brake component in proportion to the braking force built up in the service brake component and so ensuring that there is no addition of force.

## Air suspension system

The conventional air suspension system consists of an air suspension valve (17) and a lifting/lowering valve, e.g. TASC (12) see chapter 4.4 "Speed switches (ISS 1 and ISS 2)", page 61. Both valves are supplied with supply pressure from the PEM. The air suspension valve adjusts to the driving level (ride height) of the trailer vehicle by adjusting the amount of air in the support bellows (15). The lifting/lowering valve can be used to change the level of the trailer vehicle manually, e. g. for loading or unloading. In addition, a lifting axle valve (16), which is modulated by the TEBS E Modulator relative to load, may also be installed. The lifting axle valve is also supplied with supply pressure from the PEM.

### 2.1.3 Electronically controlled levelling system (ECAS)

An electronically controlled air suspension system (ECAS) is included in the TEBS E Premium variant.

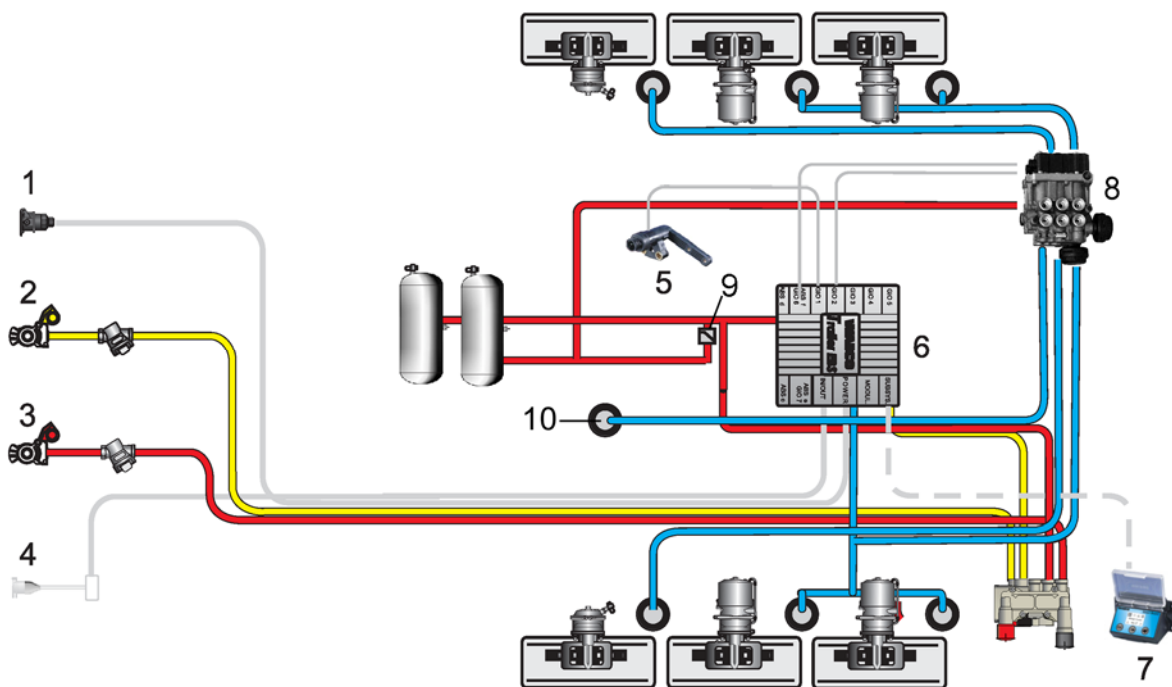
#### Components of electronically controlled air suspension (ECAS)

- Supporting Bellows
- Distance sensor
- ECAS solenoid valve
- Operation, e.g. SmartBoard, Trailer Remote Control, ECAS control unit or ECAS control box
- Integrated bellows pressure sensor for the lift axle control
- Control unit integrated in the modulator
- Pipework and cabling of the components.

With a distance sensor and an ECAS solenoid valve, **one-point control** for semitrailers is realised.

#### Example

##### Electronically controlled air suspension system (1 distance sensor) with one lifting axle



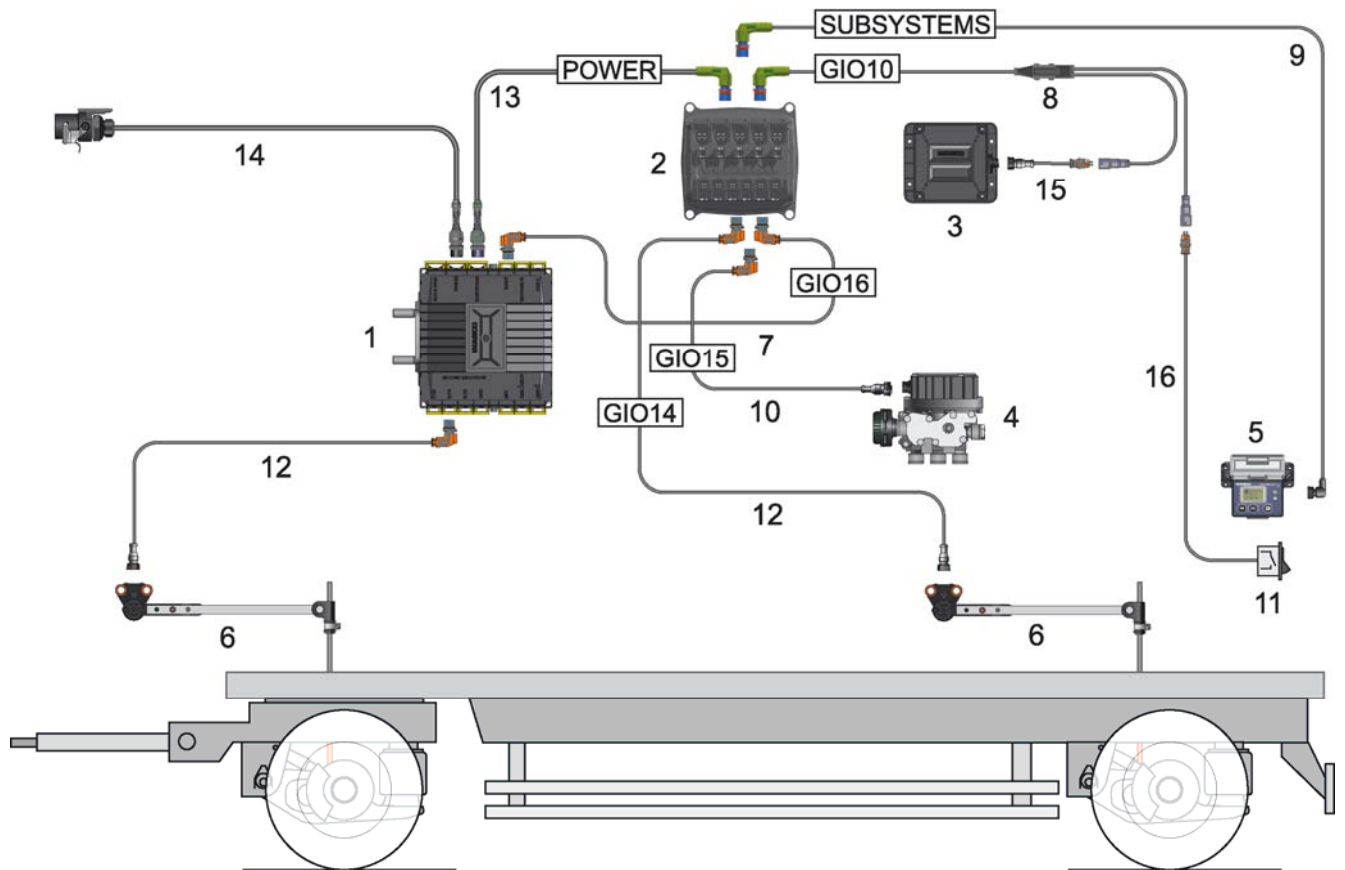
The brake lines are not shown in this schematic.

#### Legend

- |   |  |                    |
|---|--|--------------------|
| 1 Voltage supply via ISO 7638                   | 2 Control line                                 | 3 Supply line      |
| 4 Stop light supply 24N via ISO 1185 (optional) | 5 Distance sensor                              | 6 TEBS E Modulator |
| 7 External control unit, e.g. SmartBoard        | 8 ECAS solenoid valve (with lift axle control) | 9 Overflow valve   |
| 10 Lifting bellows                              |  |                    |

## Electronically controlled air suspension system (2 distance sensors)

TEBS E2



## Legend

1 TEBS E Modulator	2 Electronic expansion module (ELEX)	3 Battery box 446 156 090 0
4 ECAS solenoid valve 472 880 001 0 Optionally 472 905 111 0 (+ pulse-controlled lift axle)	5 External control unit, e.g. SmartBoard	6 Distance sensors
7 Cable "TEBS E battery supply" (GIO16) 449 808 ... 0	8 Distributor cable "Battery" (GIO10) 449 803 ... 0	9 Cable "SmartBoard" 449 906 ... 0
10 Cable "ECAS 2-point control" 449 439 ... 0	11 Switch (for activating/deactivating the battery charge)	12 Cable "Distance sensor"
13 Cable for supply ELEX 449 303 020 0	14 Power supply cable	15 TEBS E battery cable 449 807 ... 0
16 Cable for switch 449 714 ... 0		

## 3 Brake system

### 3.1 System version

The brake system Trailer EBS E is an electronically controlled brake system with load-dependent brake pressure control, automatic antiblocking system (ABS) and electronic stability control (RSS).



Trailer vehicles equipped with a trailer EBS E may only be towed by motor vehicles with an extended ISO 7638 plug-in connection (7-pin; 24 volts; towing vehicles with CAN data line) or with an ISO 7638 plug-in connection (5-pin, 24 volts; towing vehicles with no CAN-data line). This is to be documented with an entry in the certificate of acceptance.

#### TEBS E1.5

With the Multi-Voltage variant 480 102 080 0, a 12 V supply in accordance with ISO 7638 is also possible see chapter 3.7.3 "Multi-Voltage", page 28.

### 3.2 Scope of application

#### Vehicles

Trailer vehicles with one or more than one axle in classes O3 and O4 according to the framework directive 70/156/EWG, Annex II with air suspension, hydraulic suspension, mechanical suspension, disc or drum brakes.

#### Braking systems

Power braking system with a pneumatic or pneumatic-hydraulic transmission system in accordance with the regulations of the German road traffic regulations or 71/320/EEC or ECE-R13 or StVZO (applies in Germany).

#### Single and dual tyres

For each axle whose rotational speed is sensed, identical tyre dimensions and identical numbers of pole wheel teeth must be used.

A ratio of tyre circumference to pole wheel tooth count of  $\geq 23$  to  $\leq 39$  is permissible.

For a 100 tooth pole wheel and a nominal rolling circumference of the tyre of 3250 mm, the maximum wheel speed that can be processed by the EBS is  $v_{\text{wheel max.}} \leq 160 \text{ km/h}$ .

#### Brake calculation

For using the Trailer EBS E, a specific brake calculation is necessary for the vehicle or vehicle series. Speak to your WABCO partner.



#### Form "Technical vehicle data for the brake calculation for trailers"

On the Internet, call up Website <http://www.wabco-auto.com>.

Click on *Product Catalogue INFORM* => *Index*.

Enter *Brake calculation* into the search field.

Click the *Start* button.

### 3.3 Certification and standards

#### Certificates



##### Certificates

On the Internet, call up Website <http://www.wabco-auto.com>.  
Click on *Product Catalogue INFORM* => *Index*.  
Enter *Reports* into the search field.  
Click the *Start* button.

Certificate (Language)	Subject
EB 123.9E (en) ID EB 123.9E (en)	ABS
EB 124.5E (includes ID EB 124.5E) (de, en)	EBS (contains chapter "Electromagnetic compatibility" as well)
EB 167.0E (de, en)	RSS for TEBS E conforming to ECE R 13 Series 11
TUEH TB2007-019-00 (de) TUEH TB2007-019-00 (en)	ADR-GGVs-Certificate
RDW-13R-0228 (en)	Comparative expert report TEBS D / TEBS E
EB 158.0 (de, en) ID EB 158.0 (en)	Brake release and relaxation function
EB 124 CanRou 0E (en)	CAN-Router

#### Standards

Standards	Subject
ISO 1185	24 V, 7-pin plug-in connection (24N, light)
ISO 4141	Cable colours
ISO 7638	Plug-in definition and contact assignment for ABS/EBS socket
ISO 11898	5 V-CAN interface
ISO 11992	Towing vehicle trailer interface (electrical brake line)
ISO 12098	24 V, 15-pin plug-in connection
DIN 72585	Circular connector

### 3.4 ABS configuration

ABS configurations		Application	Comment
<b>2S/2M</b> (TEBS E Standard-Modulator)			
1x 2x	TEBS E Modulator ABS rotational-speed sensor	1 to 3 axle semitrailers / central axle trailers with air suspension and 1 to 3 axles, hydraulic or mechanical suspension	Each control channel has one ABS rotational-speed sensor and one pressure control channel of the TEBS E. All remaining wheels on one side of the vehicle, if any, are indirectly included in the control function; Individual braking force control (IR). In this case, each side of the vehicle is provided with the braking pressure that is possible based on the road conditions and the brake characteristics during emergency braking.
<b>2S/2M+Select-Low-Valve</b> (TEBS E Standard-Modulator)			
1x 2x 1x	TEBS E Modulator ABS rotational-speed sensor Select-Low-Valve (SLV)	1 to 3 axle semitrailers / central axle trailers with air suspension and 1 to 3 axles, hydraulic or mechanical suspension and a steering axle	The steering axle is supplied via the Select Low Valve with the respective lower pressure of the two pressure control valves so that the axle remains stable even on $\mu$ -Split (coefficients of friction on the road).
<b>4S/2M</b> (TEBS E Premium-Modulator)			
1x 4x	TEBS E Modulator ABS rotational-speed sensor	2 to 5 axle semitrailers / central axle trailers with air suspension and 1 to 3 axles, hydraulic or mechanical suspension	Two ABS rotational-speed sensors are arranged on each side of the vehicle. Control is separate for each side. The brake pressure is the same for all wheels on each side. The two wheels on this side of the vehicle with sensors are controlled based on the principle of modified side control (MSR). In this case, the first wheel to block on one side of the vehicle is the determining factor for ABS control. For the both vehicle sides the principle of individual regulation (IR) is used.
<b>4S/2M+1M+Double Check Valve</b> (TEBS E Premium-Modulator)			
1x 4x 1x 1x	TEBS E Modulator ABS rotational-speed sensor ABS relay valve Select High Valve (SHV) / Double Check Valve	For 2- to 5-axle semitrailers / 2- to 3-axle central axle trailers with air suspension, hydraulic or mechanical suspension and a steering axle.	Two ABS rotational-speed sensors, one SHV and an ABS relay valve are arranged on the steering axle. The steering axle is controlled according to the modified axle regulation (MAR) principle and the other axle according to the principle of individual control (IC).
<b>4S/3M</b> (Premium-Modulator)			
1x 4x 1x	TEBS E Modulator ABS rotational-speed sensor EBS relay valve	2- to 5-axle drawbar trailers / 2- to 5-axle semitrailers / 2- to 3-axle central axle trailers with air suspension and one steering axle.	Two ABS rotational-speed sensors, one and an EBS relay valve are arranged on the front axle. The steering axle is controlled according to the Modified Axle Control (MAR) principle. The wheel on the steering axle which tends to lock up first is dominant for ABS control. On one further axle one ABS rotational-speed sensor and one pressure control channel of the TEBS E are controlling each side separately. These wheels are individually controlled (IR).



2S/1M, 4S/4M and 6S/3M are not supported by TEBS E.

On vehicles with 5 to 10 axles, two EBS systems can be installed using the CAN router (see chapter 3.5 "Component descriptions for electro-pneumatic brake system", page 25). The 2S/2M system and the 4S/3M system can be combined here.

**Multi-axle units**

Axles or wheels which have had no sensors fitted are indirectly controlled by directly controlled axles or wheels. Multi-axle units require an almost identical adhesion utilisation on these axles when braking.

If not all wheels have sensors, those axles that have the greatest tendency to lock up are to be applied with ABS rotational-speed sensors.

Multi-axle assemblies with static axle load allocation only should be equipped in such a way (brake cylinders, length of brake levers, etc.) that the wheels of all axles reach the locking limit as simultaneously as possible and that a directly controlled wheel does not indirectly control more than two wheels or one axle.

**Lifting axles**

2S/2M: Lift axles are not to be sensed.

All other system configurations with at least 4S with the exception of drawbar trailers: Lift axles can be sensed with ABS rotational-speed sensors e-f.

**Tag axles**

Vehicles with tag axles must be equipped with a 4S/2M+1M or 4S/3M system to prevent the tag axle from locking up.

If the frame is more rigid (e.g. box bodies), a 4S/3M system must be used to prevent the outside wheel from locking up when braking in curves.

**Steering axles**

Constrained controlled axles are to be treated as rigid axles.

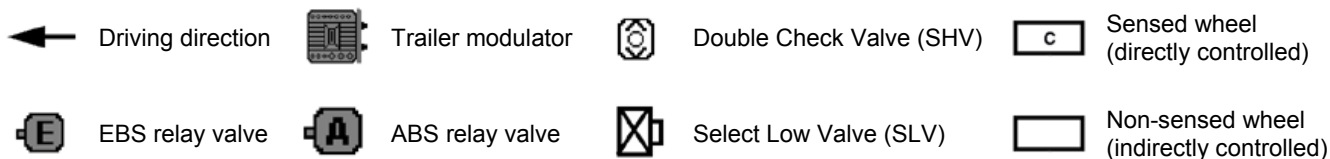
(WABCO recommendation: Trailers with self-steering axles are configured with 4S/3M, 4S/2M+1M or 2S/2M+SLV. If the vehicle is equipped with RSS, one of these configurations must be used to prevent the vehicle from breaking away in a curve when RSS actuates.

2S/2M or 4S/2M EBS systems with steering axles: During the type approval for a trailer, driving tests are to ensure that no impermissible vibrations or course-deviations occur. The reactions of all available steering axles must be evaluated during an ABS test. If additional stability is required during ABS operation for a self-steering axle, the steering axle should be switched to rigid using the speed switch (ISS).

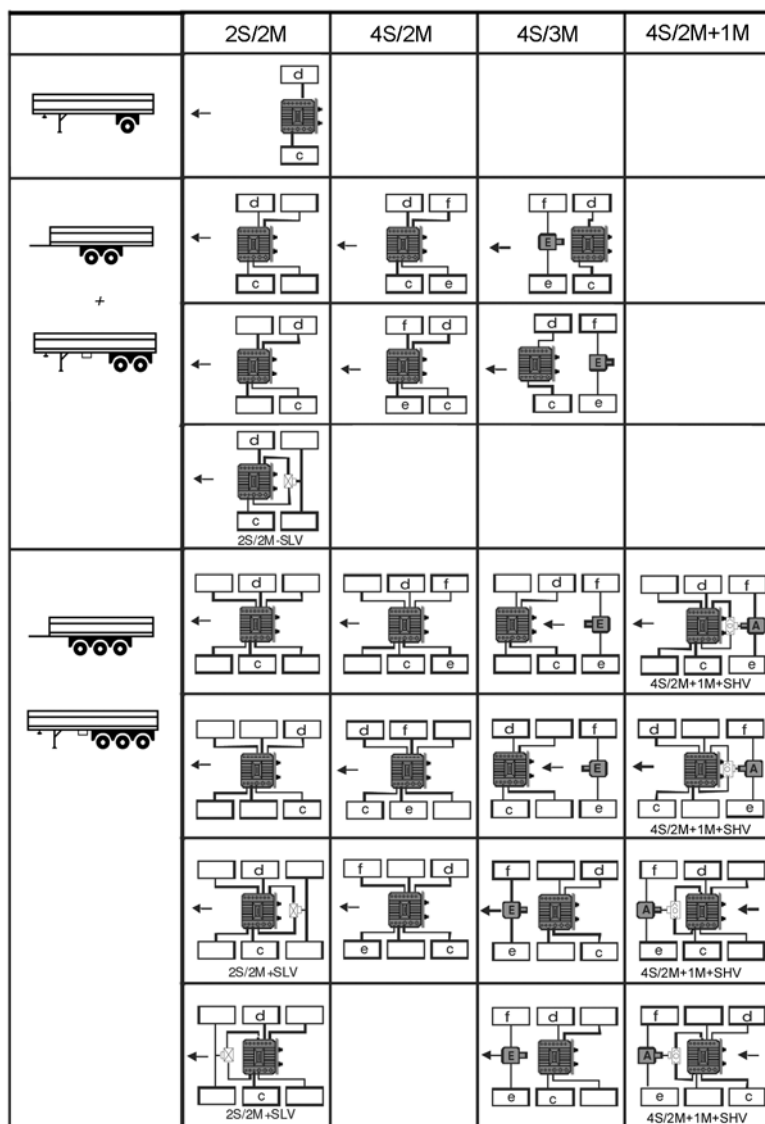
## ABS configurations and allocation of sensors/modulators

Modulator	ABS rotational-speed sensors	System axle	Control type
Trailer	c-d	Main axle (not lifting)	IR/MSR
Trailer	e-f	Additional axle (lifting)	MSR
ABS / EBS	e-f	Additional axle, steering axle or lift axle	MAR

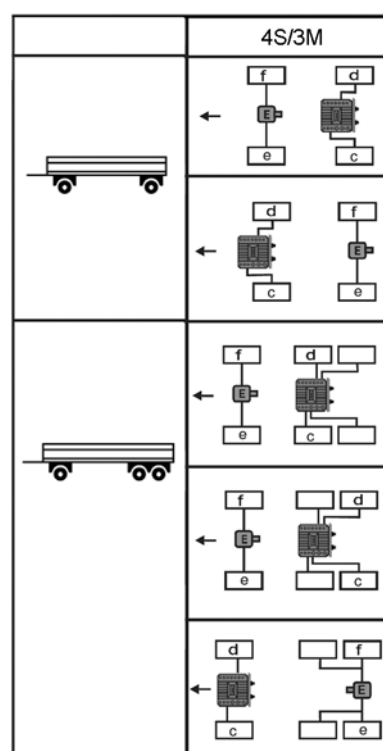
## Legend



## Semitrailer and central axle trailer














## Drawbar trailer





### 3.5 Component descriptions for electro-pneumatic brake system

Components / Part number	Application	Purpose/Function	Comment
<b>TEBS E Modulator</b> 480 102 ... 0 (Part numbers see chapter 10.1 "Overview of variants/ Pneumatic connections for TEBS E", page 164) 	All trailer vehicles	Control and monitoring of the electro-pneumatic brake system.  Side dependent control of the brake cylinder pressures on up to three axles.  Control of ABS, RSS among other things.	<b>Installation</b> In the area of the axles to be controlled. For RSS, special installation regulations apply see chapter 6.3 "Install in vehicle", page 106.
<b>TEBS E Modulator with flange-mounted Pneumatic Extension Module (PEM)</b> (Part numbers see chapter 10.1 "Overview of variants/ Pneumatic connections for TEBS E", page 164) 461 513 ... 0 	All trailer vehicles with air suspension	Pneumatic distribution module with integrated overflow valve for the air suspension and integrated overflow protection valve.  The PEM reduces the number of bolted joints and simplifies the installation of the TEBS E braking system as well.	<b>Repair kit</b> 461 513 920 2 Seal set (required for replacing the PEM)  <b>Replacement device</b> PEM 461 513 002 0
<b>EBS relay valve</b> 480 207 001 0 	On the front-/rear-axle with drawbar trailers or 3rd axle with semitrailers.  4S/3M systems	Production of the brake pressures with sensing of actual brake values.  Electrical actuation and monitoring are effected by TEBS E.	<b>Replacement device</b> Pressure sensor 441 044 108 0  <b>Repair kit</b> 480 207 920 2 Seal set
<b>ABS relay valve</b> 472 195 037 0 	3. Axle on semitrailers  4S/2M+1M systems The brake pressure produced for this axle is not monitored with this configuration.	Production of brake pressures.  Electrical actuation by TEBS E.	
<b>Park-Release-Emergency Valve (PREV)</b> 971 002 ... 0 	All trailer vehicles	Functions of the trailer brake valve and the double release valve combined in one unit (including emergency brake function).	
<b>Select-Low-Valve</b> (Double cut-off valve) 434 500 003 0 	Vehicles with 2S/2M+Select-Low control, e.g. with steering axle.	The input pressures are the pressures output by the trailer modulator for each side. The lower pressure is directed to the axle to be braked.	

Components / Part number	Application	Purpose/Function	Comment
<b>Select-High-Valve</b> (Double check valve/Two-way valve) 434 208 055 0 	Vehicles with 4S/2M+1M system for actuating the separate ABS relay valve.	The input pressures are the pressures output by the trailer modulator for each side. The higher pressure is fed to the ABS relay valve.	
<b>ABS rotational-speed sensors</b> 441 032 578 0 (0.4 m) 441 032 579 0 (1.0 m) 	On the brake mounts of the axles or the main axles.	Detection of the movement status of a rotating pole wheel together with the vehicle wheel.	<b>Repair sets</b> 441 032 921 2 441 032 922 2
<b>Pressure sensors</b> 441 044 101 0 441 044 102 0 	On one of the support bellows of the axle to be monitored.  On the yellow coupling head.	Axle load measurement.  Measurement pressure at the yellow coupling head.	
<b>CAN router</b> 446 122 050 0 (Socket) 446 122 052 0 (Plug) 446 122 054 0 (Plug-in connector; with setpoint pressure sensor) 	Tractor trailers with multiple trailer brake systems (Euro-combis or Roadtrains).  <b>Connection</b> Between towing vehicle trailer interface and TEBS E Modulator(s).	Voltage supply and distribution of CAN signals to multiple TEBS E Modulators. Up to four CAN routers in series can supply up to five TEBS E modulators.	By connecting an optional pressure sensor, the brake/control pressure is measured in the vicinity of the hose coupling and is sent as CAN signal to the TEBS E modulator connected to the outputs, to guarantee optimal response time even without an EBS towing vehicle.
<b>CAN repeater</b> 446 122 051 0 (Socket) 446 122 053 0 (Plug) 	For special vehicles, the cable lengths of which do not correspond with regulations, e.g. telescoping low-beds or long-log transporters.  <b>Connection</b> Between towing vehicle trailer interface and TEBS E Modulator.	Amplification of the CAN signal to ensure information supply for the connected TEBS E over greater distances.	ISO 11992 stipulates that the line in the trailer be maximum 18 m.  The cable length for Trailer EBS E together with the CAN repeater can be up to 80 m.
<b>Cable</b>		Connecting components	Cable overview see chapter 10.3 "Cable overview", page 171.

### 3.6 Components of the TEBS E Modulators

The TEBS E Modulator is an electronic controller with four input channels for rotational-speed sensors and one CAN interface "Towing vehicle".

The components of the modulator are:

- An internal setpoint pressure sensor "Brake pressure"
- An internal setpoint pressure sensor "Axle load"
- A backup valve for emergency operation if the power fails
- Two modulators for controlling the brake cylinders
- Two internal pressure sensors for measuring the control pressures for the brake cylinder
- One control output for controlling another axle
- One internal pressure sensor for monitoring the supply pressure
- One lateral acceleration sensor for monitoring the driving stability

### 3.7 Supply

The trailer EBS E is activated electrically via pin 2 of the ISO 7638 plug connection (terminal 15).

**WARNING**



**If the ISO 7638 plug connection to the towing vehicle is not connected, the ABS-, EBS- and RSS-control functions are no longer available.**

**Consequence:** Wheels lock, increased danger of overturning

- Instruct the driver by suitable means with regard to this circumstance (e.g. adhesive label, operating instructions).

#### 3.7.1 Function test when switching on or hooking up

Two seconds after switching on the Trailer EBS E a system check is performed and the solenoids can be heard to briefly switch on and off.



If the system check is not audible when the 7 or 5 pin ISO 7638 plug connection is connected, there is a problem in the voltage supply between towing vehicle and TEBS E (terminal 15, 30 or ground connection of the coiled cable or power cable to the Trailer EBS Modulator).

**Consequence:** The modulator is not supplied with voltage.

**Remedy:** Examine the coiled cable or power cable for continuity, as well as the plug connections on the towing vehicle for voltage (also under load).

The ABS function may only be available in a restricted form when the trailer EBS is switched on since a dynamic check of the ABS rotational-speed sensors is not performed until the start of the drive ( $v > 1.8$  km/h).

The integrated backup valves are energised for electro-pneumatic actuation at the start of braking. This means the pneumatic control pressure is diverted away and the reservoir pressure is applied to the intake valves of the modulators. This means pressure control is possible up to the level of supply pressure.

The setpoint specification for Trailer EBS (driver's desired braking effect) is predominantly specified via the electrical CAN interface "Towing vehicle" (ISO 11992). If the interface is not available, the setpoint is specified by the setpoint pressure sensor which is integrated in the TEBS E. In the case of vehicles with critical time

response behaviour, the setpoint is specified by an additional, external braking setpoint pressure sensor in the control line. The pressure is modulated by pressure control loops with pulsed relay valves.

In order to adapt the brake forces to various loading conditions, the axle loads on vehicles with air suspension and vehicles with hydraulic suspension are measured by sensing the bellows pressures. For mechanically suspended vehicles, the loading condition is determined by measuring the compression travel with one distance sensor or two distance sensors.

### 3.7.2 Power supply via brake light (24N)

In the event of a failure of the voltage supply via the ISO 7638 plug connection, the TEBS E braking system can be supplied via an optional stop light supply (24N) – as a safety function.



In accordance with ECE R 13, an exclusive supply via the brake light is not permitted. Please note that with the supply via 24N or ISO 12098 while travelling, the function "RSS" and the GIO outputs are not active.

If the ECU is only supplied by the brake light while travelling in a braking procedure, the following functions are available:

- the load-related braking force distribution (LSV function)
- the ABS with limited, delayed control characteristics
- the ISS output for actuating a rotary slide valve with RTR function (TASC)
- the ECAS RTR function

### 3.7.3 Multi-Voltage

#### Application

**TEBS E1.5**

Semitrailer, central axle trailer with maximum 4S/2M system.

**TEBS E2**

Semitrailer, central axle trailer with maximum 4S/2M+1M system.

#### Purpose

The multi-voltage variants 480 102 080 0 can be operated with 12 V towing vehicles as well as with 24 V towing vehicles.

Because there is normally no CAN signal in 12 V towing vehicles, the control pressure "Brake" is only transferred to the trailer pneumatically. The GIO outputs are also not available for connecting a valve.

The following components can be connected however.

- External pressure sensors on GIO1 or GIO3
- Buttons and switch inputs (e.g. for road finisher brakes) on the GIO1-7
- BVA on GIO1-7
- SmartBoard or IVTM on a subsystem

**Connection of the multi-voltage modulator with the tractor.**

For the installation and utilisation in mixed operation, an extra 12 V coded connection socket must be installed in addition to the 24 V coded ISO 7638 connection socket:

- 24 V connection socket with CAN signal (446 008 380 2 or 446 008 381 2)  
Use power cable 449 173 ... 0 for connecting the 24 V connection socket for example.
- 12 V connection socket without CAN signal (446 008 385 2 or 446 008 386 2)  
Use a 5-pin (if necessary 7-pin) cable for connecting the 12V connection socket.

A Y power cable must be made using a cabling box to connect the 24V and the 12V connection.

**TEBS E2**

Actuating the GIO outputs in multi-voltage mode is supported so that in addition to the previously mentioned components, the following existing valve components can also be connected now:

Multi-Voltage-capable lifting axle valve 463 084 050 0  
Multi-Voltage-capable ABS relay valve 472 196 003 0

For GIO functions that require components, the electrical load must also be defined in the TEBS E Diagnostic Software: *Valve (Buzzer)* or *Light* see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS GIO Parameter 3*.

**3.8 System monitoring****3.8.1 Warnings and system messages**

An optical warning concerning an error in the trailer system occurs via the warning lamps in the towing vehicle:

**Yellow warning light:** Actuation via pin 5 of the ISO 7638 plug-in connection

**Red warning light:** Actuation via pin 6/7 of the ISO 7638 plug-in connection (CAN signal)

In modern towing vehicles, the display of the error is realised via a display (e.g. instrument panel), the errors that occur during operation are also saved in the TEBS E.



Signals of the warning lamps are to be monitored by the driver. If the warning lamps are illuminated, a visit to the workshop is necessary. Follow the instructions on the display where applicable.

The errors are displayed according to the fault significance. The significance of the faults is divided into three classes:

**Class 0:** Light, temporary faults are indicated by the yellow warning lamp. When the fault ends, the warning lamp goes out again.

**Class 1:** Average fault, which leads to switching part functions off (e.g. ABS), are displayed by the yellow warning lamp.

**Class 2:** Serious faults in the brake system are indicated with the red warning lamp.

### Warnings after switching on the ignition

Based on ECE R13, two reactions are permitted when switching on the ignition and can be defined with the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - ABS/RSS => Warning lamp function*.

#### Type 1

When the vehicle is at a standstill:

The warning lamp in the towing vehicle illuminates after switching the ignition on.

If no current fault is detected, the warning lamp goes out after approx. 2 seconds.

If a current fault was detected, such as a sensor error, the warning lamp remains on.

If an ABS sensor fault was saved during the last drive but this fault is no longer present, the warning lamp goes out after  $v > 7$  km/h.

During driving operation  $v > 7$  km/h:

The warning lamp lights up or remains lit if a current fault was detected.

- Go to a workshop and have them rectify the fault.

#### Type 2

The warning lamp illuminates after switching the ignition on.

If no current fault was detected, the warning lamp goes out after approx. 2 seconds and lights up again after another 2 seconds.

The warning lamp goes out at  $v \geq 7$  km/h.

If a current fault was detected, such as a sensor broken, the warning lamp remains on.

- Go to a workshop and have them rectify the fault.

### Warning signal sequences in the case of voltage supply via ISO 1185/ISO 12098

The voltage supply via ISO 1185 or ISO 12098 (stop light) is provided as a safety function in order to maintain important control functions in the event of faults in the voltage supply from the ISO 7638 plug connection.

If the ISO 7638 plug connection fails completely, a warning via pin 5 is not possible.

If the connection is intact via pin 5, the warning lamp is actuated and the driver is warned.

### Warning signal sequences in the case of unspecified faults in accordance with ECE R13

After the switching-on process and the warning lamp test, unspecified faults according to ECE directives (service information such as, for example, wear see chapter 4.11 "Brake lining wear indication (BVA)", page 73) are indicated by the warning lamp flashing.

The warning lamp goes out once the vehicle's speed exceeds 10 km/h.

#### 3.8.2 Pneumatic redundancy

In the event of a system fault, which requires a (partial-) shut-down of the overall system, the pneumatic control pressure is switched through to the brake cylinder directly, however without consideration of the axle loads (LSV). The ABS function is maintained to the greatest possible extent.

The driver is notified of the system status by an illuminated red warning lamp.

## 3.9 Brake functions

### 3.9.1 Setpoint detection

The braking request issued by the driver is referred to as the setpoint.

If the trailer is towed by an EBS towing vehicle with a 7-pin (ABS) plug connection according to ISO 7638, the TEBS E gets the nominal value from the EBS vehicle via the trailer interface (CAN).

If no nominal value is available from the trailer interface, e.g. in the case of the trailer vehicle being operated behind a conventionally braked towing vehicle with 5-pin plug (ABS-) device or when the trailer interface (CAN) in EBS tractor-trailer combinations is interrupted, the desired value is generated by measuring the control pressure in the TEBS E or by using an optionally installed external setpoint pressure sensor.

To enable the pressure in the trailer vehicle to build up as quickly as possible, the nominal value received via CAN (ISO 7638, pin 6 and 7) is always prioritised for control purposes.

#### TEBS E1.5

With a supply voltage < 16 V, the towing vehicle messages for operation are no longer used, i.e. no control via the CAN setpoint.

#### TEBS E2

A parameter can be set to define whether the CAN setpoint will not be evaluated with a supply voltage of < 16 V or will be evaluated within a supply voltage range of 8 to 32 V. This way, towing vehicles with 12 V supply voltage and 12 V CAN data can be used see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - ABS/RSS => Support 12 V CAN Bus*.

When the control pressure of 0.3 bar is exceeded, the backup valve is switched to the supply pressure and the EBS braking action begins. During braking, the backup valve is briefly switched back to the control line and checked using the integrated actual value pressure sensors to establish whether pneumatic pressure is present there.

#### 3.9.1.1 External setpoint pressure sensor

##### Application

All trailer vehicles

##### Purpose

Meeting the defined timing behaviour according to ECE R 13 Annex 6 even on long vehicles without complicated valve mechanisms.


Improvement on timing for towing vehicles without EBS (no CAN signal).

##### Installation

In the control line on the front of the vehicle or directly on the CAN router or CAN repeater see chapter 3.5 "Component descriptions for electro-pneumatic brake system", page 25.



## Components

Components / Part number	Connecting cable
<b>External setpoint value sensor</b> 441 044 101 0 441 044 102 0 	449 812 ... 0

## 3.9.2 Automatic load-dependent brake force control (LSV)

## 1-circuit Axle load calculation

**Application**

For all suspension types.

**Purpose**

Trailer EBS E includes a load-dependent brake pressure control, with which the brake pressure is adapted to the load status. Characteristic curves are stored based on the braking calculations via the parameter definitions. Semitrailers and drawbar trailers are controlled differently.

The current loading condition is determined by sensing the air-suspension bellows pressure, the hydraulic pressure, by evaluating the compression travel with mechanical suspension or derived from the rotational speed differentials of the wheel speeds in two axles sensed with rotational speed.

## 2-circuit Axle load calculation (right/left)

**Application**

Trailer vehicles with separate hydraulic suspension or air suspension per side.

**Purpose**

This function enables the creation of a right-left average value of the axle loads. This improves the braking behaviour of the trailer (more precise determination of the actual load status). An additional axle load sensor is installed on the main axle c-d, which must be set in the TEBS E Diagnostic Software as *External axle load sensor* c-d, see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - function selection* => Button *Display special functions*.

## Determining the axle loads

The axle load of main axle c-d can be determined with the following options:

- Measuring the bellows pressure with a pressure sensor integrated in the modulator with air-suspension vehicles.
- Measuring the bellows pressure using an external pressure sensor for air/hydraulically suspended vehicles.
- Measuring the compression travel with a distance sensor for mechanically suspended vehicles

The axle load of additional axle e-f can be determined with the following options:

- Measuring the bellows pressure using an external pressure sensor for air/hydraulically suspended vehicles.



- Measuring the compression travel with a distance sensor for mechanically suspended vehicles
- Determining the axle load via slip detection in 4S/3M systems



#### Safety function "Vehicle on buffer"

If the bellows pressure is less than 0.15 bar or is 50 % of the defined empty bellows pressure, the LSV characteristic "Laden" is actuated, since the vehicle frame is probably on the buffer of the axle and therefore no reliable inference to the load status exists.

#### Parameter settings for LSV characteristic curve

In window *TEBS - LSV* (see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125), the values of the control pressures and the axle loads from the brake calculation and the determined bellows pressures must be entered. Normally, a linear characteristic curve shows the dependency between control pressure and brake pressure. In addition, if desired, a fourth characteristic curve coordinate can be defined with parameters.

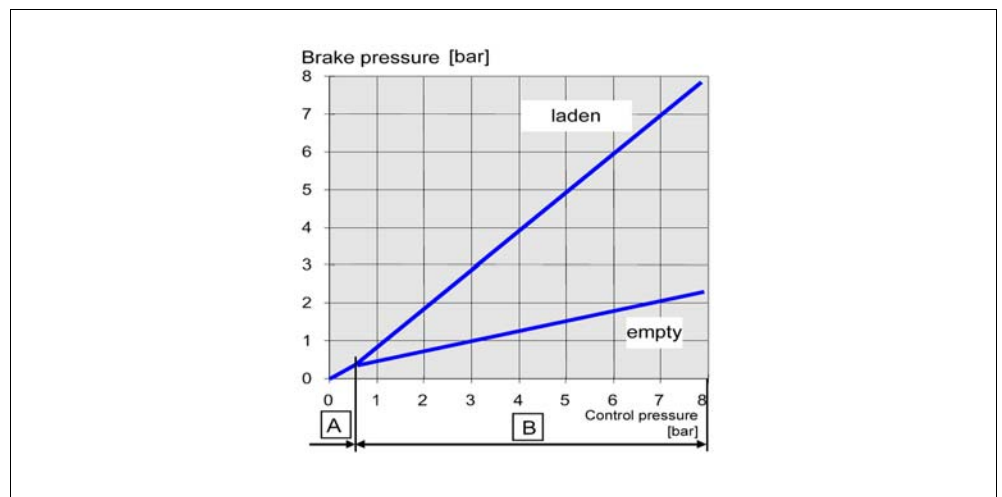
By default, three values are preset:

	Application range	Wear range	Transition range	Stability range
Pressure at the yellow coupling head (Control pressure or setpoint)	$p \leq 0.7 \text{ bar}$	$0.7 \text{ bar} < p \leq 2.0 \text{ bar}$	$2.0 \text{ bar} < p \leq 4.5 \text{ bar}$	$4.5 \text{ bar} < p \leq 6.5 \text{ bar}$
Calculated deceleration of the vehicle	0 %	at 2 bar: 11,3 %	at 4.5 bar: 38 %	at 6.5 bar: 55 %

The braking pressure level control is adapted proportionally to the measured vehicle load.

The aim is to achieve a deceleration of 55 % during all loading conditions and when the pressure at the yellow hose coupling (control pressure or setpoint) is 6.5 bar.

#### Characteristic curve for semitrailers



The transmission function *Brake pressure PB* to *setpoint (control pressure)* for semitrailer is split into two areas:

Legend	
A Application range	B Stability range

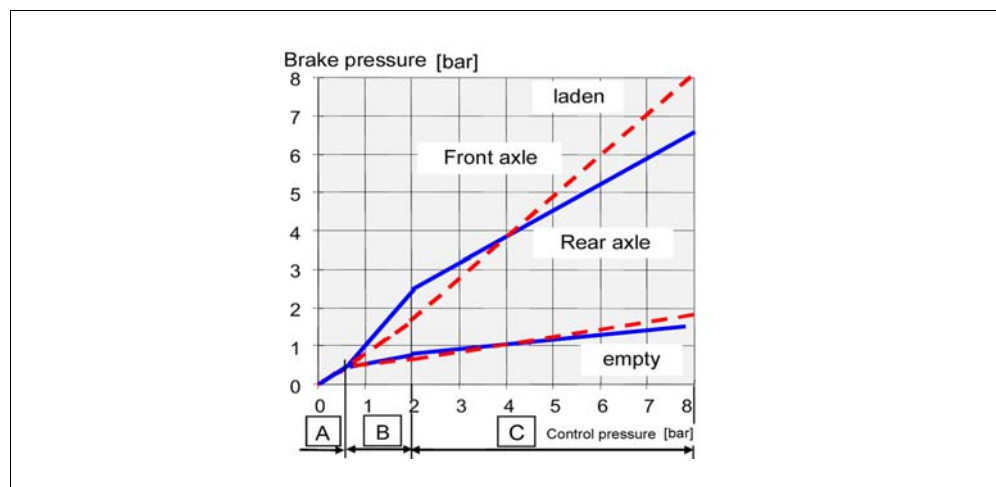
In this example, the *control pressure* increases in the application range from 0 bar to 0.7 bar. With this *control pressure*, the *brake pressure* increases from 0 to 0.4 bar.

At 0.7 bar, the response pressure in the wheel brake is reached and therefore the vehicle can start to build up braking force from that point on. This point, i.e. the response pressure for the overall trailer brake, can be defined in the parameters within EC braking bands (the braking band specifies the range within which braking must occur at a certain pressure).

As the sequence continues, the *brake pressure* follows a straight-line characteristic when the vehicle is laden. This line takes it through the calculated value at 6.5 bar.

When the vehicle is unladen, the response pressure is also applied at 0.7 bar. Afterwards, the *braking pressure* is reduced relative to the load.

### Characteristic curve for drawbar trailers



The transmission function for drawbar trailers is divided into four ranges:

#### Legend

<b>A</b> Application range	<b>B</b> Wear range	<b>C</b> Stability range
----------------------------	---------------------	--------------------------

The response pressures of the brakes are once again output at the limit of the application range. These pressures may also differ from one axle to another. In the partial braking range pressures are delivered for optimum wear.

In a drawbar trailer with type 24 cylinders on the front axle and type 20 cylinders on the rear axle, for example, the pressure at the front axle is slightly reduced and that at the rear axle is slightly increased in accordance with the configuration. This ensures that the load is distributed evenly between all wheel brakes and is more exact than the function of the adapter valve used with conventional braking systems.

In the stability range, the pressures are output in such a way as to ensure the same adhesion utilisation (possible adhesion utilisation) as a function of the axle load.

### Pressure sensor for hydraulic suspension

The pressure sensor has to be selected based on the pressures that occur. The signal output must be linear between 0.5 and 4.5 V.

Hydraulic Pressure: 0 bar = 0.5 V

Maximum system pressure

*For example:*

Hydraulic bellows pressure "unladen" = 50 bar

Hydraulic bellows pressure "laden" = 125 bar

The pressure input for the parameter TEBS LSV "laden" and "unladen" is sought after.

*Default:*

Search for hydraulic pressure sensor, which corresponds with the measuring range from 125 bar.

*Technical data for the implementation of a hydraulic pressure sensor:*

Pressure sensor "hydraulic":

0 to 250 bar => 0.5 to 4.5 V

WABCO standard EBS pressure sensor "pneumatic" as comparison value:

0 to 10 bar => 0.5 to 4.5 V

*The parameter values for TEBS E are calculated as follows:*

Range of measurement 250 bar: WABCO standard EBS pressure sensor 10 bar = 25 bar

Parameter value for bellows pressure "laden" =>  $125 \text{ bar} / 250 \text{ bar} * 10 \text{ bar} = 5 \text{ bar}$

Parameter value for bellows pressure "unladen" =>  $50 \text{ bar} / 250 \text{ bar} * 10 \text{ bar} = 2 \text{ bar}$

*Input:*

The entries are made via TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - LSV*.

### 3.9.2.1 Mechanical suspension

#### Application

Vehicle with leaf spring suspension (mechanical suspension).

Only for Premium Modulator.




#### Purpose

Axle load determination via spring travel.

#### Function

The axle load information for the LSV function is derived from the compression travel of the axle combination. ECAS distance sensors are used for this purpose. In this particular case of application the sensor delivers a signal that is proportional to the suspension travel and therefore the current axle load.

#### Components

Components / Part number	Description	Connecting cable
<b>Distance sensor</b> 441 050 100 0 	Angle of rotation principle	449 811 ... 0
<b>Linkage</b> 441 050 713 2 441 050 719 2 	Available in different lengths	
<b>Handle</b> 441 050 718 2 	Extending the distance sensor lever	

## Installation

Information on installing see chapter 6.6 "Installation Distance sensor", page 112.

## Calibration

Information on calibrating see chapter 7.4.1 "Calibration on vehicles with mechanical suspension", page 142.

### 3.9.3 Pressure control

The pressure control circuits take the setpoint pressures specified by the LSV function and convert them into cylinder pressures.

The TEBS E modulator takes the actual value pressures measured at the output of the relay valves and compares them with the setpoint pressure specification.

If there is a discrepancy, this is compensated for by actuating the inlet or exhaust solenoids of the modulator or the 3rd modulator.

If the measured supply pressure exceeds 10 bar, pressure control and ABS control is deactivated and braking is done via the backup alone.



In accordance with the EC- and ECE guidelines, a maximum of 8.5 bar supply pressure is permitted in the trailer.

### Pneumatic advance and Advance via CAN

For fine-tuning and harmonizing of brake pad wear, an advance can be defined.

The values for the pneumatic advance and CAN advance can vary.

The settings for these values can be made with the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - LSV*.

### 3.9.4 Overload protection

#### Application

All vehicles with spring-chamber cylinder.

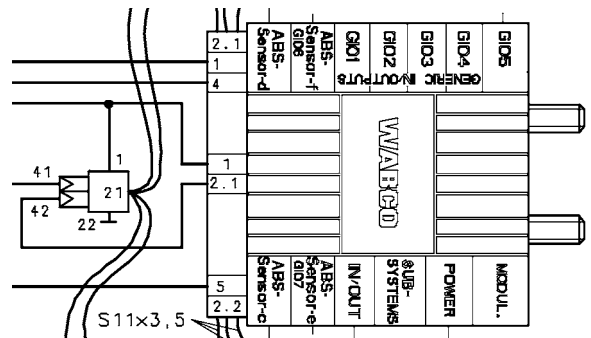
#### Purpose

For the protection of the wheel brake from overload (added force) when service and spring chamber brake are actuated simultaneously,

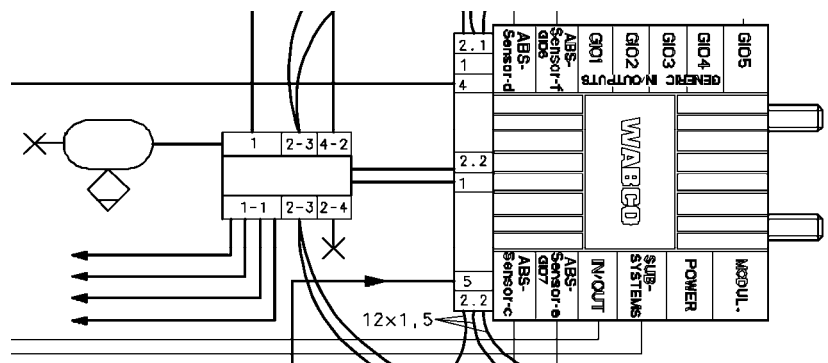
#### Components

The overload protection valve is already integrated in the PEM. If there is no PEM available, the overload protection must be ensured with a separate overload protection valve.

TEBS E modulator with overload protection valve (without PEM)



TEBS E modulator with integrated overload protection in PEM



### 3.9.5 Anti-Lock Brake System (ABS)

#### Application

All trailer vehicles

#### Purpose

Prevents locking one or more wheels.

#### Function

The control logic determines from the wheel rotation speed whether one wheel or more wheels can be locked and decides whether to decrease, maintain, or increase the braking pressure on it.

#### ABS rotational-speed sensors

Only the signals from ABS rotational-speed sensors c-d and e-f are evaluated for the ABS control logic.

In all ABS configurations (see chapter 3.4 "ABS configuration", page 22) additional brake cylinders for other axles can be connected to the existing modulators beside the brake cylinders of the sensed wheels. These indirectly controlled wheels do not send any information to the TEBS E. As a result, it is not possible to guarantee that these wheels will not lock.

#### Semitrailers, central axle trailers and dolly

The main axle, which is not to be a lift-, steering- or tag axle, always has the ABS rotational-speed sensors c-d. The ABS rotational-speed sensors e-f are fitted on the other axle or on the axles of the semitrailer that can be lifted.

**Drawbar trailer**

The sensed axles are neither to be a lift- or tag-axle with ABS rotational-speed sensors c-d or with ABS rotational-speed sensors e-f. The ABS rotational-speed sensors c-d are always to be put on the modulator side. In this case the modulator can either be installed at the front, on the drawbar or at the rear.

The status of the lift axles is understood by the ABS control logic. This means that lifting sensed axles no longer causes speeds to decrease with the ABS control. If the lift axle is raised, speed information of this axle is not considered in the control.

**Parameter definition for tyre sizes**

For optimum function of the ABS control logic it is necessary to parameterize the installed tyre dimensions see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - ABS/RSS*.

A deviation to the defined tyre dimensions by +15 % / -20 % is permissible if this affects all sensed wheels are affected to the same extent. An individual wheel may only deviate to the parameterised tyre dimension by a maximum of 6.5 %.

**3.9.6 Roll Stability Support (RSS)**

Trailers of class O4 with up to 3 axles, which are certified as of July 2010 must be equipped with a stabilisation function. RSS is mandatory as of July 2011 when certifying a vehicle for the first time. With WABCO RSS, all legal requirements concerning safety and traffic are met.

**Application**

Semitrailer / Drawbar trailer

**Purpose**

Roll Stability Support is a function integrated into the EBS, which introduces the braking procedure as a preventative measure when there is a danger of tipping to stabilize the vehicle.

**Function**

The RSS function uses the input values of the Trailer EBS E, such as wheel speeds, loading information, and target deceleration, as well as an lateral acceleration sensor that is integrated into the TEBS E Modulator.

For this purpose, test pressure activations are performed for restricted periods at low pressure if the calculated transverse acceleration critical for tilting is exceeded in the trailer. The duration and magnitude of the pressure depend on the lateral acceleration sequence.

The risk of overturning is detected on the basis of the wheel reaction of wheels braked during a test. If a danger of tilting is detected, braking action at high pressure is initiated in the trailer vehicle at least on the individually controlled (IR) outside wheels in order to reduce the vehicle speed, lateral acceleration, and therefore the danger of tilting or to prevent overturning. The brake pressure for the wheels on the inside of the curve is largely unchanged. As soon as there is no danger of tipping, the RSS braking is ended.



On an axle with a modified axle control (MAR), depending on the system it may not be possible to control the braking pressure differently for "right/left". In this case, Select-High control is actuated when a danger of tipping is detected.

RSS-control is started in the unbraked or partially braked driving condition. The RSS control is deactivated if the driver brakes heavily enough (deceleration above the level of RSS deceleration).

If the driver defines a pneumatic or electrical braking setpoint for the trailer while an RSS control is taking place, and this is higher than the RSS control, the RSS control is interrupted and the respective setpoint is used for the braking procedure.

The type of pressure control for the wheels on axle e-f depends on the vehicle type and the ABS system configuration:

Vehicle type and ABS system configuration	Comment
<ul style="list-style-type: none"> <li>Semitrailer with trailing steering axles with 4S/3M, 4S/2M+1M or 2S/2M+SLV</li> </ul>	<ul style="list-style-type: none"> <li>The MAR axle generally brakes with lower or equal pressure to ABS control (for the corner stability of adhesion-steered axles).</li> </ul>
<ul style="list-style-type: none"> <li>Drawbar trailer with 4S/3M</li> <li>Semitrailer without trailing steering axle or central axle trailer with 4S/3M or 4S/2M+1M</li> </ul>	<ul style="list-style-type: none"> <li>During the RSS control, the behaviour of the wheel on the inside of the wheel is not considered in the ABS logic.</li> <li>As long as the inside wheel of the MAR axle does not yet lift, the MAR axle will be braked with low pressure in order to avoid tyre flat spots.</li> <li>If the inside wheel of the MAR axle lifts, i.e. indicates a tendency to lock up at low pressure, the pressure increases – depending on the behaviour of both outside wheels.</li> <li>The output pressure on the MAR axle can be reduced at the outside wheel by ABS control requirements.</li> </ul>
<ul style="list-style-type: none"> <li>Vehicles with adhesion-steered steering axle with 2S/2M+SLV (Steering axle controlled via a Select Low Valve), 4S/2M+1M or 4S/3M+EBS/ABS (Steering axle MAR-controlled).</li> </ul>	<ul style="list-style-type: none"> <li>RSS on vehicles with adhesion-steered steering axle is only possible with adjacent system configurations.</li> <li>An adhesion-steered trailing steering axle must be clicked on in the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125, Window <i>TEBS - ABS/RSS =&gt; After-run steering axle</i>.</li> </ul>

### Setting the sensitivity of the RSS function for vehicles where tilting is critical

The sensitivity of the RSS function can be set in the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125, Window *TEBS - ABS/RSS => RSS parameter*.

#### 3.9.7 Standstill function

##### Application

Integrated function in TEBS E modulator.

##### Purpose

To avoid unnecessary current consumption if the vehicle is parked with the parking brake applied and the ignition switch actuated.

##### Function

When the vehicle stops, braking is done via the redundancy circuit only. The electro-pneumatic pressure control is deactivated. The function is deactivated as soon as the drive begins ( $v > 2.5 \text{ km/h}$ ).

### 3.9.8 Test mode

#### Application

Integrated function in TEBS E modulator.

#### Purpose

Check of the LSV characteristic curve in stationary vehicle.

#### Function

In this test mode, automatic load-dependent brake force control can be checked depending on the hose coupling pressure and the current axle load or the current bellows pressure.

The standstill function and the emergency brake function are deactivated for test purposes.

#### Simulation start

- Switch the ignition on with the control line depressurised (service brake system and parking brake system of towing vehicle not actuated), to switch the electronic braking system into test mode.
  - ➔ The standstill function and the emergency braking function are switched on as soon as the vehicle is driving.
  - As soon as the vehicle drives with a speed above 10 km/h, brake pressure distribution occurs, in the case of drawbar vehicles, in accordance with slip criteria or in accordance with the two measured bellows pressures.

#### Simulation vehicle laden

By depressurising the support bellows < 0.15 bar or lowering onto the buffer, the "Laden" status can be simulated when the vehicle is unladen. Corresponding with the safety function "Vehicle on buffer", the full brake pressures are produced.

Mechanical suspension: Unhook the linkage for the distance sensor and turn the lever to the position that corresponds with the spring-deflected vehicle.

#### Simulation by diagnosis

With the TEBS E Diagnostic Software, you can simulate this safety function via the menu *Control* see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125, Window *TEBS-E Diagnostic Software*.

### 3.9.9 Reservoir pressure monitoring

#### Application

Integrated function in TEBS E modulator.

#### Purpose

Monitoring the supply pressure by TEBS E.

#### Function

If the reservoir pressure drops below 4.5 bar, the driver is warned by the red and yellow warning lights switching on.

When the braking system is being charged, the warning lights do not go out until the supply pressure rises above 4.5 bar.

If, during a drive, the supply pressure drops below 4.5 bar, this is also stored as a message in the diagnostic memory.



### 3.9.10 Emergency brake function

#### Application

Integrated function in TEBS E modulator.

#### Purpose

Applying the maximum possible brake force.

#### Function

If the braking wish of the driver (electrical or pneumatic) is greater than 90 % of the available supply pressure or > 6.4 bar, i.e. panic braking is evident, a steady increase of braking pressure is applied up to the characteristic curve of the laden vehicle and up to the possible intervention of ABS control.

The emergency braking function is deactivated again once the braking wish drops below 70 % of the available supply pressure.

## 3.10 ECU-internal functions

### 3.10.1 Mileage counter

The Trailer EBS E is equipped with an integrated mileage counter which measures the distance (in km) covered during operation. The precision is determined with the tyre size relative to the defined tyre size.

The mileage counter requires operating voltage. If the Trailer EBS E is not supplied with voltage, the mileage counter does not work either and is therefore not secure against tampering.

If a SmartBoard is installed, the distance travelled is also recorded here - independently of the TEBS E. This mileage counter keeps working even when the TEBS E is not supplied with voltage.

Since the mileage counter in TEBS E counts the average values of all wheels, whereby the mileage counter in the SmartBoard counts distance on wheel sensor c, different tyre circumferences (tyre wear) can cause the mileage counters to vary.

No Y-cable is necessary for connecting the SmartBoards, since the connection is already integrated into the SmartBoard cable.

The following individual functions are possible:

#### Total mileage counter

The total mileage counter records the entire distance covered (in km) since initial installation of the TEBS E system. This value is stored regularly and can be read out using various devices (PC, SmartBoard).

#### Daily mileage counter

The trip mileage counter can determine the distance travelled between two service intervals or within a specific time span.

Reading and deleting the daily mileage counter is possible e.g. with the TEBS E Diagnostic Software or the SmartBoard.

No special calibration of the trip mileage counter is necessary. A calibration factor is calculated on the basis of the tyre tread circumferences and the number of teeth of the pole wheel from the EBS parameters. Accuracies of 1 to 3 % can be achieved.

### 3.10.2 Service signal

The service signal is there to remind the driver that service work is due to be performed.

In the condition as the TEBS E modulator is supplied, the service signal is not active. The function must be activated in the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS-E Diagnostic Software* => *Extras* => *Service interval*.

When the vehicle has covered a defined distance (e.g. 100,000 km), the warning lamp will be activated to show 8 flashes when the ignition is switched on again (while stationary or while driving). The flashing is repeated each time the ignition is actuated. Additionally the service message is stored in the Operating Data Recorder integrated in the ECU.

If the service work has been completed successfully, the service signal should be reset via the TEBS E Diagnostic Software (*Tools* => *Service interval*). If the vehicle reaches the next defined service interval (e.g. 200,000 km), the service signal is generated again.

### 3.10.3 Operating hours meter

The operating hours meter requires service voltage and functions only with a power supply, therefore switch on the ignition or via the brake light supply for braking. If the Trailer EBS E is not supplied with voltage, the operating hours counter does not work either and is therefore not secure against tampering.

The operating time for the trailer can be read by the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS-E Diagnostic Software* => *ECU DATA*.

### 3.10.4 Axle load output

Axle loads (based on the LSV values) can be output via the CAN interface to the towing vehicle or via subsystems to the SmartBoard.

In the case of vehicles with mechanical suspension however, the accuracy is restricted by the construction.

Output of the axle load does not occur and is not stored in the operating data recorder (ODR) if the following conditions apply:

- Drawbar trailer with only one axle load sensor on the axle c-d.  
The additional axle load sensor can be installed on axle e-f to output the axle load in this case.
- Vehicles with lifting axles that are not controlled by TEBS E (mechanical, TCE or external ECAS).
- On semitrailers with tag axle and without additional pressure sensor.
- If a lift axle is defined in the TEBS E Diagnostic Software, but is not controlled by the internal lift axle control, no axle load is output.

An additional axle load sensor can be installed on drawbar trailers with 4S/3M and semitrailers with 4S/2M+1M and 4S/3M to increase the quality of the measurement see chapter 4.8 "External axle load sensor", page 65. Without additional axle load sensors, the individual axle load is distributed evenly over all axles.

### Parameter setting

In order to enable the correct axle load output based on the towing vehicle being used, the transmission of individual message content for axle load can be deacti-

vated in the TEBS E Diagnostic Software with a special parameter definition *CAN messages ISO 11992* see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS E - ABS/RSS* => *EBS22 no output of total axle load* or *RGE22 no output for single axle loads*.

### Fine calibration


In order to attain higher precision of the axle load output, a calibration of the output can be performed with the SmartBoard. This requires an additional characteristic curve based on the weights of an unladen, partially laden and fully laden vehicle. A detailed description can be found in the SmartBoard system description.



#### SmartBoard system description

On the Internet, call up Website <http://www.wabco-auto.com>.  
Click on *Product Catalogue INFORM* => *Index*.  
Enter the word *SmartBoard* into the search field.  
Click the *Start* button.

### Components

Components / Part number	Description	Connecting cable
<b>SmartBoard</b> 446 192 11. 0 	Possibilities: <ul style="list-style-type: none"> <li>• Calibration of the axle load output</li> <li>• Axle load output</li> <li>• Optionally it is also possible to program the unit so that the red warning lamp flashes when the axle load reaches 90 % and 100 % to indicate the danger of overloading when loading particulate material for example.</li> </ul>	449 911 ... 0

### 3.10.5 Notebook function

#### TEBS E2

### Application

All trailer vehicles

### Purpose

Manual saving and display of vehicle data or TEBS E data, such as e.g. listing the installed components or data on the service history of the vehicle.

The data is stored in table format in the memory of the TEBS E. In total, the storage space based on the number of characters takes up approximately one letter sized page, which can be divided into a maximum of 10 columns. The number of available lines is limited by the number of text characters.

### Using the function

#### Activating the function

- Call up the function via the TEBS E Diagnostic Software.  
The function does not require any further parameter definition and is located in window *TEBS-E Diagnostic Software* under *Tools* => *Notebook* see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125.

**Loading, processing and saving a file**

- Open the notebook function (*Tools => Notebook*).
- Press button *Read from file*.
- If necessary, edit the content and save the change in the TEBS E with button *Write to file*.

**Loading and saving an external table**

- Open the notebook function (*Tools => Notebook*).
- A CSV file (e.g. from Excel) can be saved, which must be located on the diagnostics PC or a connected USB stick. This is done by loading the file using the button *Read from file*. The file cannot contain any formatting or special characters.
- Save the data to the TEBS E with button *Write to file*.

**3.10.6 Operating data recorder (ODR)****Purpose**

Saving various data to document vehicle operation and enabling inference on the driving behaviour.

This operating data can be evaluated directly on the vehicle using the PC analysis tool "ODR-Tracker".

The operating data recorder is split into "Historical data" (trip recorder, histogram) and the "event recorder", which is explained further below.

It is possible to protect against deleting the ODR data with a password defined by the user. The password can be assigned by the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS-E Diagnostic Software => ODR => Password management*.

**Historical data**

The historical data is stored as sums or mean values over the unit's service life or starting from the last time the Operating Data Recorder (ODR) was erased.

Historical data are:

- Operating hours
- Number of trips
- Average load
- Overload counter (trips)
- Average braking pressure
- Number of brake actions
- Number of brake actuations with pressure on yellow hose coupling
- Number of braking procedures in 24N operation
- Number of brake actuations with anti-jackknifing brake
- Number of hand brake actuations
- Mileage counter and operating hours since the brake linings were last replaced
- Data pertaining to air suspension system and lifting axle activation

**Trip recorder**

A trip has a travel distance of at least 5 km and a minimum speed of 30 km/h. The trip recorder stores data from the last 200 trips.

The following data is recorded per trip:

- Kilometres at start of drive
- Distance driven in kilometres
- Operating hours at start of drive
- Driving hours
- Maximum speed
- Average speed
- Medium control pressure
- Brake actuations
- Braking frequency
- Aggregate load at beginning of trip
- ABS brake actions
- RSS interventions, stage 1
- RSS interventions, stage 2

If a SmartBoard connected, the trips are provided with time and date information.

### Histogram

A histogram represents the distribution of events as they occur over the operating time of the vehicle.

All histograms consist of 8 classes. This means that the values are grouped according to stages/levels (for example 0-15 %; 16-30 %).

Histograms			
Aggregate load (sum of all axles)	Axle load (axle load for one axle)	Braking time	Control pressure
Recording the travelled kilometres per combined multi-axle class.	Recording the travelled kilometres per combined axle load class.	Recording the braking time per class and the maximum occurring pressure.	Recording the braking procedures per class and the maximum occurring pressure.

A detailed description of the histograms can be obtained from the ODR Tracker operating instructions.



### ODR tracker manual

On the Internet, call up Website <http://www.wabco-auto.com>.

Click on *Product Catalogue INFORM* => *Index*.

Enter the word *ODR* into the search field.

Click the *Start* button.

### Even recorder

The event recorder stores the number of events (a maximum of 200), braking system events that is.


Each event is saved together with the time of occurrence and the mileage at that time in the TEBS E Modulator.

Such events include e. g.:

- ABS interventions
- RSS interventions
- Warning lamp on
- Messages
- Manual deactivation from TailGUARD

- Immobilizer events
- events definable by GIO parameter settings (e. g. if a connected door contact switch indicates the opening of a door)

### Components

Components / Part number	Description	Connecting cable
<b>ODR tracker program</b> 446 301 536 0 (de) 446 301 692 0 (en)	On USB stick for use with computers having Windows operating systems.	
<b>SmartBoard</b> 446 192 110 0 	Optional  Expands the ODR data with time and date information.	449 911 ... 0

## 4 GIO Functions

This chapter describes functions that can be created using the GIO interfaces of the TEBS modulator and other components. Normally, a Premium modulator is required for these functions (see following table "Overview of GIO functions").

### Introduction to GIO

GIO means Generic Input/Output and designates programmable inputs and outputs. The Standard variant of the Trailer EBS E Modulator has 4 GIO slots, the Premium variant has 7 GIO slots. With GIO-functions, it is possible to activate various additional functions in the trailer modulator.

#### TEBS E2

More GIO slots are made available via the electronic expansion module ELEX (see chapter 5.1 "Electronic expansion module (ELEX)", page 89) to enable the connection of additional components.

The standard functions are allocated with the TEBS E Diagnostic Software. Some functions have multiple uses (e.g. Integrated lift axle control, speed switch ISS, permanent positive voltage).

The parameter settings can be used to assign different functions to the GIO slots. The parameter settings can also be used to choose whether outputs should be monitored for line breaks for safety reasons.

All GIO slots have at least one switching output (power stage) and one ground contact. The other two pins are variably assigned. The implication is that not all functions can be realised on all slots to the same extent see chapter 10.2 "Pin assignment", page 166. The maximum load for all GIO switching outputs is 1.5 A.



GIO functions are available if the power to the system is sufficient and fault-free.

### GIO power stage

The GIO power stage can be used to switch electrical loads (e.g. solenoid valves, lamps) or to detect the switching condition to ground of a switch.

The GIO power stages can also be used as inputs. In this case, whether a switch is open or connected to ground can be sensed. If the switch is switched to positive, a fault is detected when the switch is closed.

### GIO analogue input

The GIO analogue input can be used to read in analogue signals (e.g. from pressure sensor) or to detect signals from buttons.

The sensors are supplied with voltage by the GIO power stage.

### GIO distance sensor input

ECAS distance sensors can be connected to the GIO distance sensor inputs as height sensor in a level control system or in the case of mechanically suspended vehicles for sensing the compression travel as a means to determine the axle load.

## Overview of GIO functions

	Standard Modulator	Premium Modulator	TEBS E	TEBS E1	TEBS E1.5	TEBS E2
Lift axle control with LACV	✓	✓	✓	✓	✓	✓
Lift axle control with LACV-IC		✓			✓	✓
Tag axle control with residual pressure maintenance		✓				✓
Electronic levelling control (ECAS 1 point control)		✓	✓	✓	✓	✓
Switching off from ECAS		✓				✓
Green warning light		✓				✓
Deactivating the automatic levelling control		✓				✓
Speed switch (ISS1, ISS2)	✓	✓	✓	✓	✓	✓
RSS active signal	✓	✓	✓	✓	✓	✓
ABS active signal	✓	✓	✓	✓	✓	✓
Traction help	✓	✓	✓	✓	✓	✓
External axle load sensor	✓	✓	✓	✓	✓	✓
OptiTurn™ (manoeuvring aid)		✓		✓	✓	✓
OptiLoad™ (drawbar load reduction)		✓		✓	✓	✓
Forced lowering	✓	✓	✓	✓	✓	✓
Brake pad wear indicator	✓	✓	✓	✓	✓	✓
Power supply from Telematics (GIO5)		✓	✓	✓	✓	✓
Speed signal	✓	✓	✓	✓	✓	✓
Steady positive voltage 1 and 2	✓	✓	✓	✓	✓	✓
Battery supply	✓	✓	✓	✓	✓	✓
Finisher brake	✓	✓	✓	✓	✓	✓
Trailer Extending Control	✓	✓				✓
Relaxation function	✓	✓		✓	✓	✓
Steering axle lock	✓	✓		✓	✓	✓
Tilt warning	✓	✓		✓	✓	✓
Forklift control		✓				✓
Brake release function	✓	✓		✓	✓	✓
Additional brake light (Emergency Brake Light)		✓				✓
Immobilizer (Immobilizer)		✓			✓	✓
Freely configurable functions	✓	✓	✓	✓	✓	✓



## 4.1 Lift axle controller

### Application

Trailer vehicle with one lift axle or multiple lift axles.



#### Lift axle control in drawbar trailer

With 3-axle drawbar trailer, it is possible to have axle 2 or 3 as a lift axle. If the TEBS Modulator is installed on the front axle of the vehicle, the rear axle, which remains on the ground must be monitored with an external pressure sensor.

### Purpose

Control of the lift axles by TEBS E depending on the current axle load and the current load status.

### Function

The driving speed, at which lifting the lift axle(s) is permitted, can be defined between 0 and 30 km/h.

The sequence for lifting the axles can be set in the parameter definition (see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 1 => Automatic lift axle control*). Parameters are set for the pressure applied for lifting and lowering the lifting axle. The 1st lifting axle is always lifted first and then the second lifting axle.

The TEBS E Diagnostic Software provides intelligent bellows pressure values for the lift axle control. These suggestions can however be adapted by the user for special vehicles (e.g. 3-axle drawbar trailer with forklift transport).

The position of the lifting axles is transmitted to the "Towing vehicle" CAN interface and can be displayed there on the instrument panel provided the required equipment is installed.

#### TEBS E1

The bellows and supply pressure are checked as of TEBS E1. The lift axle is no longer raised if the vehicle has been lowered to the buffer or the supply pressure is too low (< 6.5 bar).

A new plausibility check for the lift axles is also integrated when lifting or lowering to prevent a so-called Jo-Jo-Effect. This Jo-Jo-Effect always occurs if the pressure difference between lifting/lowering pressure is < 1.0 bar.

This pressure difference is checked with the entry in the TEBS E1 Diagnostic Software and an appropriate notice is provided when entering the parameter.

If the ISO 7638 voltage supply does not exist while the towing vehicle is driving and therefore the ECU is supplied only via the 24N stop light supply, there is no lift axle control.

Only if ISO 7638 voltage supply is guaranteed and  $v = 0$  km/h, will the lift axle control work correctly.

#### Setting the behaviour of the lift axle with the ignition switched off

The conduct of the lift axle (raised or lowered) can be adjusted with the vehicle shut down (when ignition off) in the TEBS E Diagnostic Software and depends on the construction of the lift axle valve.

The pulse-controlled lift axle valve can actuate the lift axle lift/lower position after switching the ignition off.

The spring-retained lift axle valve can only actuate the lift axle lowered position after switching the ignition off.

**Lift axle control LA1**

The following connections are possible: A spring-return lift axle control valve 464 084 0.. 0 or a pulse-controlled lift axle valve 463 084 100 0 or a pulse-controlled ECAS solenoid valve block with lift axle control 472 905 114 0




**Lift axle control LA2**



You have the following connecting methods available for controlling the 2nd lift axle: A spring-return lift axle valve 463 084 0.. 0 or a pulse-controlled lift axle valve 463 084 100 0

**Components**

**Pulse-controlled:** The valve has two solenoids and a holding position at which the lifting axle can be partially exhausted.

**Spring-returned:** The lift axle is lowered or raised, without intermediate positions. If the voltage is switched off, the lifting axle is lowered.

Components / Part number	Application	Purpose/Function	Description	Connecting cable
<b>Lifting axle valve</b> <b>LACV</b> <b>463 084 0.. 0</b> 	All trailer vehicles with lift axle(s)	Control of up to two lift axles automatically, i.e. depending on the current axle load, by TEBS E.  Electrical actuation and monitoring are effected by TEBS E.  Traction help possible with residual pressure maintenance (only with added solenoid valve, e.g. 472 173 226 0).	463 084 031 0 1-circuit, spring-returned, without bolted joints  463 084 041 0 1-circuit, spring-returned, with bolted joints  463 084 042 0 1-circuit, spring-returned  463 084 050 0 12 V variant with NPTF thread (imperial); for multi-voltage applications	449 443 ... 0
<b>Lift axle valve</b> <b>463 084 010 0</b> 	All trailer vehicles with lift axle(s)	Control of up to two lift axles in a 2-circuit air-suspension system automatically, i.e. depending on the current axle load, by TEBS E.	2-circuit, spring-returned	449 443 ... 0  Without DIN bayonet connection; this requires the use of adapter 894 601 135 2.
<b>Lifting axle valve</b> <b>LACV-IC</b> <b>463 084 100 0</b> 	All trailer vehicles with lift axle(s)	Utilisation of a lift axle for actuating the additional axle in 3-axle semitrailers for dynamic wheel-base control (OptiTurn™ / Opti-Load™).  Utilisation for the immobilizer for actuating the spring accumulator.  Electrical actuation and monitoring are effected by TEBS E.  Traction help possible with residual pressure maintenance.	Pulse-controlled	449 445 ... 0 or 449 761 ... 0

Components / Part number	Application	Purpose/Function	Description	Connecting cable
<b>ECAS solenoid valve</b> 472 905 114 0 	Semitrailer/drawbar trailer (with lifting axle)	1-point control Control of the vehicle level for one axle or multiple axles. Raise/lower one or two parallel controlled lift axles. Electrical actuation and monitoring are effected by TEBS E. Traction help possible with residual pressure maintenance.	2 circuit, pulse-controlled	449 445 ... 0 (2x)
<b>ECAS solenoid valve</b> 472 905 111 0 	Semitrailer/drawbar trailer (with lifting axle)	2-point control Control of the vehicle level for one axle or multiple axles. Raise/lower one or two parallel controlled lift axles. Electrical actuation and monitoring are effected by TEBS E. Traction help possible with residual pressure maintenance.	2-circuit 2-point control, only possible in combination with ELEX and TEBS E2. + pulse-controlled lift axle	Cable "Valve" 449 445 ... 0 Cable "ECAS 2-point control" 449 439 ... 0

**TEBS E2**

As of TEBS E2, three pulse-controlled valves can be controlled in parallel on the TEBS E Modulator.

**WABCO recommendation for the valve selection for lift axles**

	Lifting axle valve spring returned 463 084 010 0	Lifting axle valve spring returned 463 084 031 0	Lifting axle valve pulse- controlled 463 084 100 0	ECAS sole- noid valve pulse- controlled 472 905 114 0	ECAS sole- noid valve pulse- controlled 472 905 111 0
<b>Behaviour of the lift axle with the ignition switched off</b>					
Lift axle remains in the desired and defined position (lifted or lowered).			In combination with TEBS E Modulator 480 102 06. 0 (Premium)		
			✓	✓	✓
Lift axle lowers.	In combination with TEBS E Modulator 480 102 03. 0 (Standard)				
	✓	✓			
<b>Lift axle control, Traction help, Forced lowering, OptiTurn™/OptiLoad™</b>					
A lift axle without dynamic wheelbase control.	In combination with TEBS E Modulator 480 102 03. 0 (Standard) / 480 102 06. 0 (Premium)				
	✓	✓	✓	✓	✓
Two lift axle without dynamic wheelbase control.					
<b>Recommendation of the axle manufacturer:</b> With two lift axles, one lift axle should be 2 circuit.	✓	✓	✓	✓	✓
<b>Dynamic wheelbase control</b> One lift axle or tag axle with dynamic wheelbase control on axle 3 for axle load distribution with load or automatic lift in a curve			In combination with TEBS E Modulator 480 102 06. 0 (Premium)		
			✓	✓	✓

**Operation**

Information on operation see chapter 8.5 "Operation lift axles", page 154.

**4.2 Tag axle control with residual pressure maintenance****Application**

Semitrailer with tag axles / trailing steering axles.

Semitrailer with tag axles and OptiTurn™ / OptiLoad™-function see chapter 4.9 "Dynamic wheelbase control", page 66.



This function is not suitable for drawbar trailers. A 4S/3M or 4S/2M+1M system and an additional axle load sensor e-f must be installed.

**Purpose**

When using tag axles, the bellows should not be completely depleted of air since otherwise parts of the air bellows will rub against one another and cause damage.

The integrated function helps avoid tyre damage with a residual pressure maintenance in the support bellows, increased tyre wear and possible damage to the bellows. No further components are required for the residual pressure maintenance.

### Installation

With tag axles, the wheel speed must be sensed and the braking controlled via a separate modulator. (WABCO recommendation: Brake the tag axle using an EBS relay valve (4S/3M).

An external axle load sensor e-f must also be installed to measure the bellows pressures on the tag axle. To control the tag axle, a pulse controlled lift axle valve (LACV-IC) must also be used.



The implementation of spring-returned lift axle valves is not possible.

### Residual pressure setting

- Select the residual pressure depending on the installed support bellows set in parameter settings *Automatic lift axle control* in the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 1*.  
The residual pressure can be set from 0.3 bar.

## 4.3 Electronically controlled air suspension (ECAS)

### Application

All trailer vehicles with air suspension.

### Purpose

The ECAS basic function is the compensation of level changes, which e.g. occur from changes in the load status or with new setpoint definitions (e.g. from the control unit). These control deviations cause the distance between the vehicle's axle and its superstructure to change. ECAS balances these control deviations by means of levelling control.

### Operating principle of the ECAS base system

A distance sensor is mounted on the vehicle body and is connected to its axle via a lever system. The distance sensor picks up the distance between the axle and the vehicle body / body. The intervals depend on the vehicle's operating time (driving or loading operation).

This measured value is used as the actual value in the control loop and is sent to the electronic control unit. The ECU compares this actual value to the nominal value predefined in the ECU.

In the event of a difference between the actual value and the setpoint value (control deviation), the ECAS solenoid valve receives an actuating signal. Depending on the type of actuating signal received, the ECAS solenoid valve now increases or decreases the air pressure in the supporting bellows. The change in pressure in the supporting bellows alters the distance between the axle and the vehicle body. The new distance is also picked up by the distance sensor, and the cycle begins again.




There are two controls for height change with the electronic levelling control (ECAS).

	1-point control	2-point control <b>TEBS E2</b>
Application	Semitrailers or central axle trailers with one distance sensor	<p>Drawbar trailer with two distance sensors (1x on front axle, 1x on rear axle)</p> <p>Semitrailer with independent wheel suspension, with two distance sensors (1x right vehicle side, 1x left vehicle side defective above the average axle combination)</p> <p>Utilisation with semitrailers or central axle trailers and rigid axles is not permitted.</p>
Actuating the ECAS functionality	Integration in the TEBS E Premium modulator	Integration in the TEBS E Premium Modulator and ELEX or external ECAS.
Connection	Directly on the TEBS E modulator	Directly on the TEBS E modulator and ELEX or with an external ECAS kit 446 120 024 0 (external ECAS required!).
Installation		Make sure that only the higher bellows pressure is fed to the trailer modulator with right/left control. Use a Select-High valve for this.







Further information for 2-point control see chapter 5.1.3 "ECAS 2-point control", page 95.

## Components

Components / Part number	Application	Purpose/Function	Comment	Cable
<b>TEBS E Modulator with flange-mounted PEM</b> 480 102 06. 0 	All trailer vehicles with air suspension.	Control and monitoring of the electronic air suspension.	<p>Premium-Modulator with PEM</p> <p>Connection of up to two ECAS solenoid valves and one distance sensor.</p>	
<b>ELEX</b> 446 122 070 0 	In combination with TEBS E2 Modulator	2-point control	2-point control, only possible in combination with ELEX and TEBS E2.	<p>Cable "Valve" 449 445 ... 0</p> <p>Cable "ECAS 2-point control" 449 439 ... 0</p>
<b>ECAS solenoid valve</b> 472 880 030 0 	Semitrailer/drawbar trailer (without lifting axle)	<p>1-point control</p> <p>Control of the vehicle level on one or multiple axles on parallel circuits (lift/lower).</p>		Cable "Valve" 449 445 ... 0

Components / Part number	Application	Purpose/Function	Comment	Cable
<b>ECAS solenoid valve</b> 472 880 001 0 	Semitrailer/drawbar trailer (without lifting axle)	2-point control  Control of the vehicle level on one or multiple axles on parallel circuits (lift/lower).	2-point control, only possible in combination with ELEX and TEBS E2.	Cable "ECAS 2-point control" 449 439 ... 0
<b>ECAS solenoid valve</b> 472 905 114 0 	Semitrailer/drawbar trailer (with lifting axle)	1-point control  Control of the vehicle level on one or multiple axles on parallel circuits (lift/lower).	Pulse-controlled lift axle	Cable "Valve" 449 445 ... 0
<b>ECAS solenoid valve</b> 472 905 111 0 	Semitrailer/drawbar trailer (with lifting axle)	2-point control  Control of the vehicle level on one or multiple axles on parallel circuits (lift/lower).	2-point control, only possible in combination with ELEX and TEBS E2.  Pulse-controlled lift axle	Cable "Valve" 449 445 ... 0  Cable "ECAS 2-point control" 449 439 ... 0
<b>Distance sensor with angle of rotation principle</b> 441 050 100 0 	Semitrailer / Drawbar trailer with air suspension	Normal level measurement	Use only distance sensor 441 050 100 0.	Cable "Distance sensor" 449 811 ... 0
<b>Lever</b> 441 050 718 2 	Attaching the distance sensor	Extending the distance sensor lever		
<b>Linkage</b> 433 401 003 0 	Connection to the axle			
<b>ECAS control box</b> 446 156 02. 0 	446 156 021 0 Semitrailer without lifting axle  446 156 022 0 Semitrailer with lifting axle  446 156 023 0 Drawbar trailer	Remote control unit  Influence of the level and the lift axle control by the driver.		Cable "ECAS control box" 449 627 ... 0

Components / Part number	Application	Purpose/Function	Comment	Cable
<b>ECAS control unit</b> 446 056 117 0 	Semitrailer / Drawbar trailer	Control unit (with 9 buttons), installed in the trailer.  Influence of the level and the lift axle control by the driver.		Cable "ECAS control unit" 449 628 ... 0
<b>ECAS remote control unit</b> 446 056 25. 0 	Semitrailer / Drawbar trailer	Control unit (with 12 buttons) for vehicle combination control from towing vehicle  Influence of the level and the lift axle control by the driver.		Cable "ECAS control unit" 449 628 ... 0
<b>SmartBoard</b> 446 192 11. 0 	446 192 110 0 (with integrated battery)  446 192 111 0 for hazardous vehicles	Display and control panel  Influence of the level and the lift axle control by the driver.	Replacement battery 446 192 920 2	Cable "ECAS control unit" 449 628 ... 0
<b>Trailer Remote Control</b> 446 122 080 0 	On the Motor Vehicle	Display and control panel in driver's cab  Influence of the level and the lift axle control by the driver.	Only in combination with ELEX and TEBS E2 see chapter 5.1 "Electronic expansion module (ELEX)", page 89.	Connecting cable between Trailer Remote Control and fuse box in the HGV and a bracket are contained with the delivery.

#### 4.3.1 Nominal level control

##### Nominal level

The nominal level is the reference value for the distance between vehicle body and vehicle axle. This nominal level is defined by calibration, by setting parameters or by the driver (e.g. via the SmartBoard).

##### Function

The actuator is a solenoid valve, which by increasing and decreasing the pressure in the supporting bellows bringing the actual level into line with the nominal level.

This occurs if there are:

- Control deviations exceeding a tolerance range (e.g. with changes in weight)
- Change to the specified value for the nominal level (e.g. by selecting a memory level)

Unlike conventional air suspension systems, ECAS controls not only the driving level but also any other predefined level. Therefore a level which is set for loading or unloading processes is assumed to be the nominal level.



In other words, If the loading condition changes, the vehicle remains at the set level, whereas in vehicles with conventional air suspension this level must be adjusted manually or the vehicle body lowers when laden and raises when unladen.

If the power supply is interrupted or if the air supply is insufficient, e.g. when the ignition is switched off, no further nominal level control occurs when the ignition is switched of.

Parameter *After ignition, the actual level is the same as the nominal level* (see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2* => Button *Extended ECAS parameter* => *Other functions*) ensures that a level that changes while the ignition is switched off (e.g. with a loss of air, weight change) is automatically set as the new actual level when the ignition is switched on. This causes the suppression of sudden adjustments.

By using the speed signal the electronic levelling control system differentiates between static and dynamic changes in the load, unlike conventional air suspension systems. A level change is adjusted with a delay while driving. If the vehicle e.g. also adjusted while compressing on washboard sections, was subjected to an unnecessary compressed air consumption otherwise.

	Static wheel load change	Dynamic wheel load change
Application	<ul style="list-style-type: none"> <li>At load change</li> <li>At standstill</li> <li>At low vehicle speeds</li> </ul>	<ul style="list-style-type: none"> <li>Dynamic wheel load changes are caused by road irregularities at higher speeds.</li> <li>The wheel load changes on an uphill or downhill stretch, which affects the control performance.</li> </ul>
Control functions	Checks the actual value and corrects if necessary by adding or removing air at the respective air suspension bellows in short intervals (e.g. 1x per second – can be defined by parameters) by the electronic level control see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window <i>TEBS - GIO parameter 2</i> => Button <i>Extended ECAS parameter</i> => <i>Control delay</i> .	Dynamic wheel load changes are usually balanced by the compliance behaviour of the supporting bellows. In this case, bellow charging or venting would not be desirable because only the bellow that is isolated has almost constant suspension properties. When the excess air is exhausted from the bellow during rebound action, it must be replaced again during compression which increases compressor load and fuel consumption. For this reason, the regulation is checked at larger intervals when the vehicle is moving at higher speed - usually every 60 seconds. The comparison of actual value to the nominal value is made continuously.
Comment	Parameters can be defined for the static control time interval.	Because not every unevenness on the road is compensated, e.g. when driving on roads in bad condition, less air is consumed by the electronic air suspension than by conventional levelling control systems with air-suspension valve.

#### 4.3.2 Driving level

##### Driving level I (Normal level)

Driving level I (normal level) refers to the nominal level defined by the vehicle manufacturer for driving under optimal conditions (optimum body height). It has a special meaning compared to other driving levels.

Driving level I is defined by the overall vehicle height, which is bound by legal guidelines and the height of the vehicle centre of gravity that is especially important for driving dynamics.

Driving normal level is described as the basic design parameter for the vehicle.

### Driving level II

Driving level II is defined as the difference to driving level I (normal level). If driving level II is lower than driving level I, this value must be entered as a negative in the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2 => Height control*.

#### Application

- If the semi trailer is operated behind different towing vehicles (with different platform heights) the body can be set level.

### Driving level III

Driving level III is a driving level like driving level II but it corresponds with the maximum body height and is therefore the highest driving level.

#### TEBS E2

Driving level III could only be selected by the speed previously. As of TEBS E2, the selection is now possible by the ECAS control unit as well.

#### Application

- Used for adjusting the trailer to various platform heights.
- For fuel saving (e.g. at higher speed).
- For lowering the vehicle centre of gravity to achieve more lateral stability.

Lowering the superstructure depending on the vehicle's speed, is based on the assumption that higher speeds are achieved on sound road surfaces which do not require the whole of the bellows' spring stroke to be utilised.

### Driving level IV

#### TEBS E2

Whether the unloading level or driving level IV should be used is selected by parameter definition see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - function selection*.

#### Application

- As additional driving level.

### Unloading level

The unloading level is only actuated at a standstill or at low speed for easier unloading of the vehicle. When the speed is achieved, the last saved level is readjusted automatically.

#### Application

- Lower a tipper vehicle to prevent hard rebounds because of a sudden release (dumping the load).
- Moving road tankers automatically into the best unloading position.
- Improving stability.

### Unloading level switch

For example: The switch is attached on a tipping body, the vehicle will then lower automatically into a defined level, as soon as the body is tipped. Ideally this value corresponds to the buffer or lower calibration level. This avoids overloading the axle combination during sudden unloading.

This function is automatically deactivated  $v > 10$  km/h.

If the parameterised unloading level is outside the parameterised lower or upper level, the stroke is restricted to this level.

An unloading level is only realised between the upper and lower calibration level - even when the parameter settings specify a value outside this range.

**TEBS E1**

The unloading level can be switched off at times with the SmartBoard, e.g. for operating before road finishers.

**TEBS E1****Parameter for unloading level**

There are 2 parameters for the unloading level in the TEBS E Diagnostic Software:

- Lowering the body to the buffer
- Lowering the body to the lowest calibrated level

These parameters also apply for actuating this function via the SmartBoard or the ECAS control box.

A speed-dependent parameter was created for the unloading level in the TEBS E Diagnostic Software. This means that the unloading level as well as the driving level IV (normal level IV) can be used. It is also possible to run switch inputs for driving level I, driving level II or driving level IV independent of one another.

**Memory level**

Unlike the unloading level, which is defined in the ECU, the memory level can be defined and changed by the driver any time. Once defined, the system will store any memory level until it is changed by the user, i.e. even when the ignition has been switched off. The memory level applies to the whole of the vehicle.

For each system two different memory levels can be used. An ECAS remote control unit or the SmartBoard is required to request the memory function.

**Application**

- Repeating loading operation on a ramp with height defined one time.

**4.3.3 Green warning lamp****Application**

All trailer vehicles with ECAS.

Assembly on the trailer vehicle into the driver's field of vision (above rear mirror).

**Purpose**

Light switched off: The vehicle is within the driving level and no messages exist.

Light switched on: The vehicle is outside the driving level.

- Move the vehicle into driving level if necessary. The selected driving level is the reference level.

Status display of ECAS function "Flashing": An ECAS message exists.

- Read the diagnostic memory with TEBS E Diagnostic Software and rectify the fault.

**Installation**

- Connect a green warning light (LED or bulb) in a free GIO slot (GIO1-7) to use the function.

### Activating the function / selecting the warning light

In menu item *Extended ECAS parameter*, the function can be activated and the parameters can be defined see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2*.

- Activate the function by clicking on *Warning light installed*. With an LED, click on parameter as *LED* (no cable break detection).
- Set parameter *Behaviour in case of faults*, to define the warning light signal that will be used to indicate a fault. If faults exist, the type of fault can be shown via the TEBS E Diagnostic Software or via the SmartBoard.

### Components

Components / Part number	Description
LED or bulb	Not part of WABCO's scope of supply.

### 4.3.4 Deactivation of the automatic level control

#### Application

All trailer vehicles with (TEBS E internal) ECAS.

#### Purpose


Deactivation of the automatic level control, e.g. while loading or unloading to reduce the air consumption on the ramp.

- Connect a switch to a free GIO connection (GIO1-7) or a SmartBoard to the GIO connection "Subsystems".

#### Switch option setting

- Define the parameters for the switch in the function selection (GIO1-7).  
The level control can only be deactivated while stationary (< 3 km/h).  
As soon as a speed is detected (> 5 km/h), the automatic level control is deactivated again.
- In order to reactivate this function, actuate the switch while at a standstill again.

**!** With this function, all lift axle functions, such as e.g. automatic lifting axle control, traction help, OptiTurn™ etc. are ended and all lift axles are lowered. The lift axle functions remain switched off, even if the vehicle is moving again and the automatic level control is reactivated, until the basic parameters for activating the lift axle function are achieved again.

Components / Part number	Description	Connecting cable
Switch	Not part of WABCO's scope of supply. Activating / Deactivating the function	Universal cable 449 535 ... 0
SmartBoard 446 192 11. 0 	Alternative to switch Activating / Deactivating the function	449 911 ... 0

## 4.4 Speed switches (ISS 1 and ISS 2)

### Application

All trailer vehicles

### Purpose

By means of the two integrated speed switches ISS 1 and ISS 2 it is possible to control two functions in the trailer, independently of one another.

### Function

The switching condition of the output changes if the vehicle drives faster than or slower than a speed limit set in the parameters. Consequently it is possible to switch on and off solenoid valves dependent on the speed.


A typical application example is locking steering axles (see chapter 4.18 "Steering axle lock", page 79) or actuating the TASC with a pulse when exceeding the speed. The two speed limits at which the switching condition of the output changes can be set in the parameters anywhere between 0 and 120 km/h. A minimum switching hysteresis of 2 km/h must be observed.

The switching output is switched off below the speed limit set in the parameters. When achieving the limit, the output is switched on and a voltage of +24 V is output. The shifting function can also be inverted by defining a parameter so that +24V is applied in neutral position.

In the case of solenoid valves which are not high-endurance, a 30 second pulse can be triggered if the parameterised speed limit is exceeded (e.g. pulse-controlled gate valve). In the event of a fault, make sure that the apparatus controlled from the switch-output does not remain in a state that will affect the safety of driving the vehicle.

For example, a steering axle should be locked if there is an electrical power supply failure since that represents the safe condition.

### Components

Components / Part number	Type	Connecting cable
<b>TASC</b> 463 090 0.. 0 	463 090 012 0 1-circuit; RTR, Resting in lowered position	449 443 ... 0
	463 090 020 0 2-circuit; RTR, Resting in lowered position, with fittings and test connection	
	463 090 021 0 2-circuit; RTR, Resting in lowered position, with fittings	
	463 090 023 0 2-circuit; RTR, Resting in lowered position	
	463 090 123 0 2-circuit; RTR, deadman switch for stroke > 300 mm	

## 4.5 RSS active signal

The Trailer EBS E Modulator is equipped with the RSS function. While the RSS function is active and there is an active RSS intervention the brake lights of the vehicle are not actuated actively.

**TEBS E1**

A signal is sent to the towing vehicle via the CAN data connection and the brake light is requested. Depending on the construction of the towing vehicle, the actuation of the brake lights is supported.

In addition, the RSS active signal also makes it possible to actuate the brake lights when the RSS function is active by the TEBS E. For this purpose it is necessary to parameterize this output via the GIO function.

Control may be realised via a relay. The supply voltage for the brake lamps must come from the 15-pin plug connection (ECE regulation).

Components / Part number	Description	Connecting cable
<b>Relay</b>	Not part of WABCO's scope of supply	Universal cable 449 535 ... 0

## 4.6 ABS active signal

When the ABS control is active, WABCO switches an output, e.g. for controlling (deactivating) a retarder.

Components / Part number	Description	Connecting cable
<b>Relay</b>	Not part of WABCO's scope of supply	Universal cable 449 535 ... 0

## 4.7 Traction help

### Application

All air suspended trailer vehicles with lift axle or tag axles as first axle.

### Purpose

On slippery ground or on steep hills vehicles have a hard time or cannot start to move. The drive axle of the vehicle does not have enough traction and the wheels spin. With traction help, the 1st axle on a semitrailer can be raised or relieved of pressure. The subsequent weight adjustment on the semitrailer coupling causes the traction of the drive axle of the towing vehicle to increase.

When connecting a SmartBoard to the TEBS E Modulator (Subsystems) and defining the respective parameters that no switch is used, traction help conforming with 98/12/EC can be used with semitrailers with a lifting 1st axle. The value that corresponds to maximum 30 % overload in accordance with the EC-guidelines must be defined by the vehicle manufacturer.

When reaching 30 km/h, the axle is lowered again or returns to automatic mode.



Note the axle manufacturer's information for the traction help. These specifications may restrict the max. limits of the EEC directive.

### Recommended valve configurations

The following variants can be selected:

- **A spring-return lift axle valve (not suitable for all vehicles)**

The lifting axle can be lifted as a traction help providing the permitted bellows pressure set in the parameters is not exceeded after lifting. If the permitted pressure is exceeded when traction help is active, traction help is cancelled and the respective lifting axle is lowered.

In countries where axle loads of 3 times 9 t are permitted, traction help is cancelled as soon as the load on the axles that remain in the ground exceeds 23.4 t. The effect of traction help is thus linked to the loading condition.

- **One lifting axle valve (spring-returned) and one solenoid valve for pressure limiting (residual pressure maintenance)**

The load is transferred off the lifting axle as a traction help, up to the level of the permitted bellows pressure set in the parameters. Then the supporting bellows of the lifting axle is shut off using the solenoid valve. The lifting axle is thereby relieved for best possible traction when starting without exceeding the 30 % overload on the other axles.

(The lift axle remains relieved at 130 % axle load on the main axle and is lowered again only at 30 km/h.)

This configuration permits traction help even when the vehicle is overloaded.

- **A pulse-controlled lift axle valve**

The load is transferred off the lifting axle as a traction help, up to the level of the permitted bellows pressure set in the parameters. Then the support and lifting bellows of the lifting axle are shut off. Therefore, relieving the lifting may also be performed in order not to exceed the permissible 30 % overload.

(The lift axle remains relieved at 130 % axle load on the main axle and is lowered again only at 30 km/h.)

This arrangement makes sense in countries with a permissible axle load of 9 t.

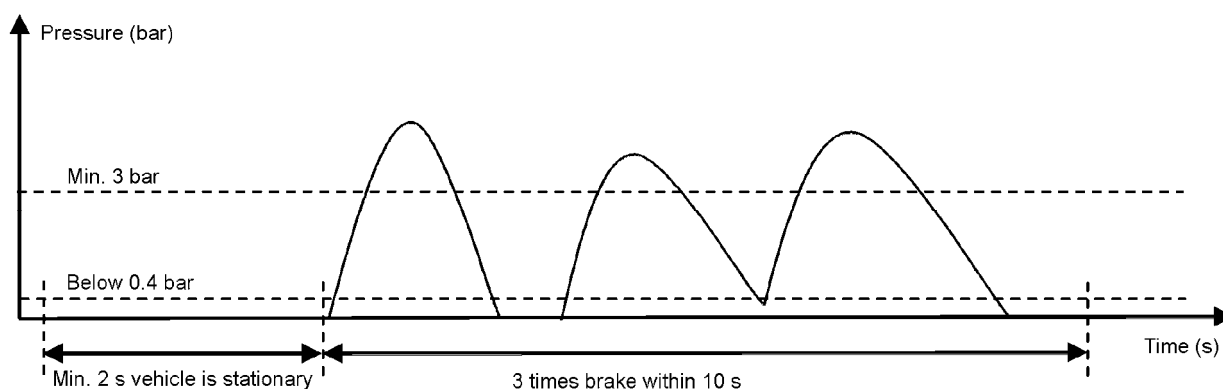
#### Activation of traction help

- **ISO 7638:** Actuation via the CAN interface "Towing vehicle" from tow vehicle.
- **SmartBoard:** Activation via the control menu of the SmartBoard.
- **Trailer Remote Control:** Activation via button "Traction help" see chapter 8.2 "Operation with Trailer Remote Control", page 147.
- **Brake actuation:** By activating this parameter, the traction help can be activated or deactivated by actuating the brake 3 times, at a standstill (between the three brake actuations, the pressure must drop below 0.4 bar). The following condition applies here: Vehicle is stationary. The brake must be actuated and released three times with a pressure of 3 to 8 bar after a period of 10 seconds without braking pressure.

By actuating the brake 3 more times, the traction help is deactivated again.

Forced lowering for the axles is not possible by actuating the brakes.

**Example of brake actuation to activate traction help**



**TEBS E2**

Automatic activation via parameter *Traction help automatic with curve detection* see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS E - GIO parameter 1*.

**TEBS E1****Traction help**

The traction help function is supported for lift axles on the last axle for semitrailers or central axle trailers, i.e. the lift axle is raised or lowered upon request.

**Activation:** 1-time actuation of the button (less than 5 seconds).

**Traction help "type Northern":**

A time-dependent control of the traction help is also possible (in 1 second steps, max. 1,200 seconds).

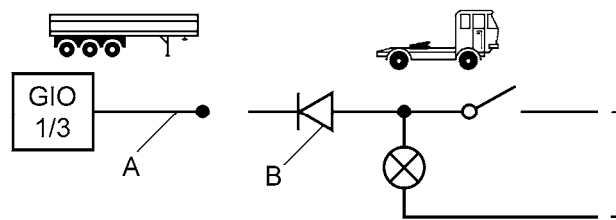
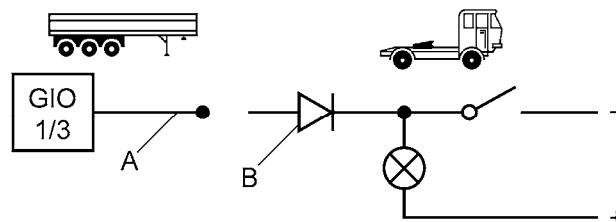
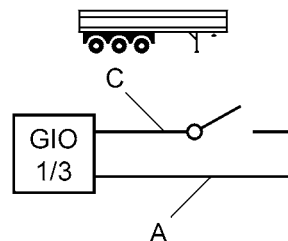
For lift axle valve 463 084 3.. 0 the lift axle is lowered automatically after exceeding 130 % of the axle load, after 5 seconds.

**Activation:** 1-time actuation of the button (less than 5 seconds).

**Traction help "off-road"**

This function has been executed to allow brief higher pressures (thresholds) for the traction help function for private traffic.

**Activation:** Actuate the button twice briefly.

**Trailer/signal from towing vehicle +24 V****Trailer/signal from towing vehicle - (ground)****Button in trailer****Legend****A** Pin 3**B** Diode**C** Pin 2



## 4.8 External axle load sensor

An external axle load sensor may be used instead of the internal axle load sensor.

### For axle c-d

#### Application

Vehicles with hydraulic suspension for example because suspension pressures of up to 200 bar are required here (vehicles that cannot connected to the TEBS E modulator because of too high pressures).

#### Purpose

The external axle load sensor may be retrofitted on the main axle should the internal sensor fail. This avoids replacing the module and a cost-efficient repair can be performed instead.

#### TEBS E2

#### New function: Second ext. axle load sensor c-d

With hydraulically suspended vehicles, the right and left axle load can be detected separately by using a second pressure sensor to ensure that the vehicle does not over- or under-brake when the load differs from side to side, this new function *Second ext. Axle load sensor c-d* makes it possible to detect an average value from both external pressure sensors see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - function selection* => Button *Display special functions*. This average value is used for determining the brake pressure and for outputting the axle load. This function is not suitable for drawbar trailers.

### For axle e-f

#### Application

Drawbar trailer, semitrailer (only 3M) with lift axles or tag axles, OptiTurn™ / OptiLoad™

#### Purpose


More precise determination of the axle loads.

#### Function

Transmission of the information for total weight of the trailer via the ISO 7638 plug-in connection to the towing vehicle and show on the display.

If a SmartBoard is installed, the separate loads of the drawbar trailer axles (front and rear axle) can also be displayed.

### Components

Components / Part numbers	Description	Connecting cable
<b>Pressure sensor</b> 441 044 101 0 441 044 102 0 441 044 108 0 	0 to 10 bar  441 044 108 0 only for EBS relay valve!	449 812 ... 0

## 4.9 Dynamic wheelbase control

### 4.9.1 Drawbar load reduction (OptiLoad™)

#### Application

Semitrailers with 2 or 3 axles, rear axle as a tag axle or lifting axle.

#### Purpose

Avoid overloading fifth wheel and towing vehicle drive axle on semitrailers with loads that are unevenly distributed in the direction of the towing vehicle.

#### Function

Lifting and relieving pressure on the rear lifting axle improves the distribution of the load between the towing vehicle and the semitrailer thus avoiding overloading of the rear axle of the towing vehicle. In this case, the rear axle of the semitrailer acts as a counterweight to the load.



The function can be deactivated if relieving the towing vehicle rear axle is unreasonable with an unladen vehicle or in winter operation.

#### Benefit

- The load does not have to be distributed over the load surface.
- Reduces the risk of a traffic fine due to overloading the towing vehicle.

#### Parameter settings OptiLoad™

Information on parameter definition see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 1*.

#### Activation condition selections

- Automatically upon exceeding the speed (define parameters as of 0 km/h).
- Only at partial-/full-load: With unladen vehicles, the function is deactivated automatically. The ECU switches to the automatic lift axle.
- Manually with button (Press manoeuvre assistance button two times); optional via SmartBoard or Trailer Remote Control.

#### Deactivation condition selections

- Pressure value limitation, at which the function is deactivated (under the defined bellows pressure, the function is active).
- Manually with button; optionally via SmartBoard or Trailer Remote Control.



The pressure value for the drawbar load reduction is only allowed to be maximum 100% of the bellows pressure "laden".

#### Control options

##### Permanently Automatic

The function starts independent of the driver according to the defined boundary conditions.

If a SmartBoard is installed, the automatic function can be deactivated temporarily, to save air for instance. The OptiLoad™ is reactivated after the ignition has been switched off and on again (Trip function).

The Automatic function can also be switched off completely and then reactivated again via the SmartBoard.

The Manoeuvre assistance button or the Trailer Remote Control (only in combination with ELEX and TEBS E2) can be used to put the Automatic function into Forced lowering mode by pressing the button for > 5 seconds. The OptiLoad™ is reactivated after the ignition has been switched off and on again (Trip function).

#### Manual control

As soon as OptiLoad™ is deactivated the systems stays in this situation until it is reactivated via the SmartBoard or by actuating the Manoeuvre assistance button.

The SmartBoard or the Trailer Remote Control (only in combination with ELEX) can be used as an alternative to the button. After switching the ignition off and back on again or by switching off with the SmartBoard, Trailer Remote Control or Manoeuvre assistance button, OptiLoad™ is deactivated again.

### 4.9.2 Manoeuvre assistance (OptiTurn™)

#### Application

Semitrailers with 2 or 3 axles, rear axle as a tag axle or lifting axle.

#### Purpose

Increasing manoeuvrability.

Can be used as an alternative to trailing steering axle.

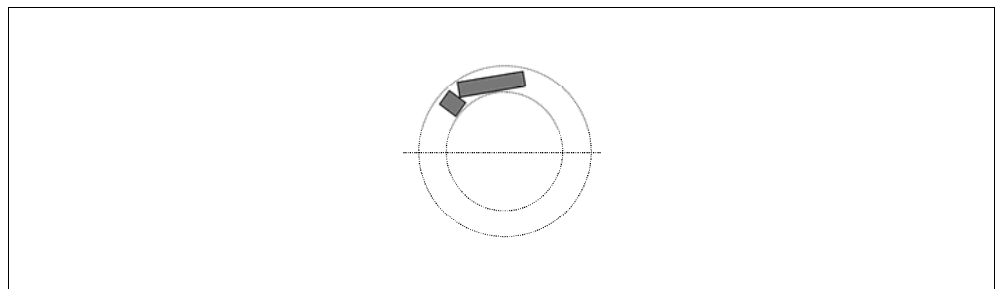
#### Function

OptiTurn™ is able to detect tight curves from the differing wheel speeds and correspondingly unloads the rear axle according to the specifications of the traction help. This causes the fulcrum of the axle unit to "migrate" from the central axle between the two loaded axles remaining on the ground and reduces the turning circle and improves the manoeuvrability of the whole vehicle. The load on the third axle can be defined based on the parameter settings.

#### Benefit

- Reduced tyre wear in tight curves.
- Can save steering axle and steering axle control.
- Improves manoeuvrability, even when reversing.

#### BO force circuit



The BO BOforce circuit specifies the maximum circle radius that is permissible by law for trailer vehicles. The outer diameter of the circle is 25.0 m, the inner diameter of the circle 10.6 m. With OptiTurn™, the legal turning radius is easily maintained.

## Parameter settings OptiTurn™

Information on parameter definition see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 1*.

### Activation condition selections

When dropping below the speed (maximum 30 km/h): The function starts with a delay of 60 seconds under the defined speed.

**Observe the following:** After each time the ignition is switched on, the vehicle must exceed the set speed at least one time to activate the function.

With curve detection: The function starts under the defined speed immediately when entering a curve. After the curve is complete, the function is deactivated until the next curve is detected.

Only at partial-/full-load: With unladen vehicles, the function is deactivated automatically. The ECU switches to the automatic lift axle.

### Deactivation condition selections

Automatic at a defined speed at which the function should be deactivated (maximum 30 km/h).

Automatic when achieving a certain bellows pressure, at which the function should be deactivated or frozen (e.g. when reaching the maximum permitted bellows pressure 100 %).

Pay attention to the permitted axle loads corresponding with the axle manufacturer's information.

If the Tristop® cylinders are installed on axle 2 and 3, the parameter *Lifting axle function (OptiTurn/OptiLoad) interrupted with parking brake engaged*.

## Control options

### Permanently Automatic

The function starts independent of the driver according to the defined boundary conditions.

If a SmartBoard is installed, the automatic function can be deactivated temporarily, to save air for instance. The OptiTurn™ is reactivated after the ignition has been switched off and on again (Trip function).

The Automatic function can also be switched off completely and then reactivated again via the SmartBoard.

Automatic can be completely activated again via the SmartBoard. The Manoeuvre assistance button or the Trailer Remote Control (only in combination with ELEX and TEBS E2) can be used to put the automatic function into forced lowering mode by pressing the button for > 5 seconds.

The OptiTurn™ is reactivated after the ignition has been switched off and on again (Trip function).

### Manual control

OptiTurn™ remains deactivated until it is reactivated by actuating the Manoeuvre assistance button.

The function is started manually with the manoeuvre assistance button: Press manoeuvre assistance button 1 time.

The SmartBoard or the Trailer Remote Control (only in combination with ELEX and TEBS E2) can be used as an alternative to the button.

After switching the ignition off and back on again or by switching off with the SmartBoard, TRC or Manoeuvre assistance button, OptiTurn™ is deactivated again.






### 4.9.3 Recommended components



#### OptiLoad™/OptiTurn™ in combination with ECAS

For an optimal and efficient utilisation of the functions (response time & optimal weight distribution), an electronically controlled air suspension system is recommended (raising & lowering + control of the Opti-function axle).

#### GIO diagram 841 802 235 0 / 841 802 236 0

GIO diagrams see chapter 10.5 "GIO diagrams", page 181.

Components / Part number	Application	Purpose/Function	Comment
<b>TEBSE Premium</b> 480 102 06. 0 	All trailer vehicles with 4S/3M system.	Control and monitoring of the electro-pneumatic brake system.  Side dependent control of the brake cylinder pressures on up to three axles.  Control of ABS, RSS among other things.	<b>Installation</b> In the area of the axles to be controlled.
<b>EBS relay valve</b> 480 207 ... 0 	On the front-/rear-axle with drawbar trailers or 3rd axle (additional axle) with semi-trailers with 4S/3M system.	Production of the brake pressures with sensing of actual brake values.  Electrical actuation and monitoring are effected by TEBS E.	3. Modulator
<b>ECAS solenoid valve</b> 472 905 111 0 	Semitrailer/drawbar trailer (with lifting axle)	2-point control  Control of the vehicle level for one axle or multiple axles (lift/lower).  Electrical actuation and monitoring are effected by TEBS E.	2-point control, only possible in combination with ELEX and TEBS E2.  Pulse-controlled lift axle
<b>ECAS solenoid valve</b> 472 905 114 0 	Semitrailer/drawbar trailer (with lifting axle)	1-point control  Control of the vehicle level for one axle or multiple axles (lift/lower).  Electrical actuation and monitoring are effected by TEBS E.	Pulse-controlled lift axle
<b>Lifting axle valve</b> LACV-IC 463 084 100 0 	All trailer vehicles with lift axle.	Utilisation of a lift axle for actuating the additional axle in 3-axle semitrailers for dynamic wheelbase control.  Utilisation for the immobilizer for actuating the spring accumulator.  Electrical actuation and monitoring are effected by TEBS E.  Traction help possible with residual pressure maintenance.	Pulse-controlled  When using a second lift axle for the first axle: <i>Up to TEBS E2:</i> In combination with the ECAS double block, only the spring-retained lift axle valve can be used on the first axle. <i>From TEBS E2:</i> An additional third pulse-controlled valve can also be installed.




Components / Part number	Application	Purpose/Function	Comment
<b>External bellows pressure sensor</b> 441 044 ... 0 	On one of the support bellows of the axle to be monitored.  On the yellow coupling head.	Axle load measurement.  Measurement pressure at the yellow coupling head.  The bellows pressure sensor provides an optimal actuation for braking pressure on the last axle when unladen; this brake pressure is calculated on the last axle depending on the respective pressure (by loading or vibrating the vehicle frame) thereby preventing the wheels from locking.	Optional  <b>Installation</b> The external bellows pressure sensor must be installed depending on the construction of the vehicle frame and under the responsibility of the vehicle manufacturer with an especially flexible and soft frame.
<b>SmartBoard</b> 446 192 11. 0 	446 192 110 0 (with integrated battery) for Trailers  446 192 111 0 for transporting dangerous goods	Display and control panel	Optionally: Manoeuvre assistance button or Trailer Remote Control





#### OptiLoad™/OptiTurn™ in combination with a conventional air suspension

This equipment series never achieves the optimal and efficient degree of utilisation of the function advantages.

**GIO diagram 841 802 240 0 (tag axle) / 841 802 241 0 (lift axle)**

GIO diagrams see chapter 10.5 "GIO diagrams", page 181.

Components / Part number	Application	Purpose/Function	Comment
<b>TEBSE Premium</b> 480 102 06. 0 	All trailer vehicles with 4S/3M system.	Control and monitoring of the electro-pneumatic brake system.  Side dependent control of the brake cylinder pressures on up to three axles.  Control of ABS, RSS among other things.	<b>Installation</b> In the area of the axles to be controlled.
<b>EBS relay valve</b> 480 207 ... 0 	On the front-/rear-axle with drawbar trailers or 3rd axle (additional axle) with semitrailers with 4S/3M system.	Production of the brake pressures with sensing of actual brake values.  Electrical actuation and monitoring are effected by TEBS E.	3. Modulator
<b>TASC</b> 463 090 ... 0 	All trailer vehicles with lift axle.	Lifting/lowering the vehicle body.  The chassis is automatically returned to normal driving level when the vehicle starts driving (RTR – Return-To-Ride).	Optionally: Rotary slide valve 463 032 ... 0

Components / Part number	Application	Purpose/Function	Comment
<b>Lifting axle valve</b> LACV-IC 463 084 100 0 	All trailer vehicles with lift axle	Utilisation of a lift axle for actuating the additional axle in 3-axle semitrailers for dynamic wheelbase control.  Utilisation for the immobilizer for actuating the spring accumulator.  Electrical actuation and monitoring are effected by TEBS E.  Traction help possible with residual pressure maintenance.	Pulse-controlled  When using a second lift axle for the first axle: <i>Up to TEBS E2:</i> In combination with the ECAS double block, only the spring-returned lift axle valve can be used on the first axle. <i>As of TEBS E2:</i> An additional third pulse-controlled valve can also be installed.
<b>Residual pressure keeper valve</b> 475 019 ... 0 	All trailer vehicles with tag axle.	Mechanical residual pressure maintenance.  Automatic resupply of compressed air as soon as the pressure drops below the set value.  Prevents the bellows from collapsing or becoming damaged.	Optional with tag axle  <b>Installation</b> It is installed for the air bellows of the last axle see chapter 4.2 "Tag axle control with residual pressure maintenance", page 52.  <i>From TEBS E2:</i> This function can also be generated via the internal parameter <i>Tag axle residual pressure control</i> see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window <i>TEBS - GIO parameter 1</i> .
<b>External bellows pressure sensor</b> 441 044 ... 0 	On one of the support bellows of the axle to be monitored.  On the yellow coupling head.	Axle load measurement.  Measurement pressure at the yellow coupling head.  The bellows pressure sensor provides an optimal actuation for braking pressure on the last axle when unladen; this brake pressure is calculated on the last axle depending on the respective pressure (by loading or vibrating the vehicle frame) thereby preventing the wheels from blocking.	Optional  <b>Installation</b> The external bellows pressure sensor must be installed depending on the construction of the vehicle frame and under the responsibility of the vehicle manufacturer with an especially flexible and soft frame.
<b>SmartBoard</b> 446 192 11. 0 	446 192 110 0 (with integrated battery) for Trailers  446 192 111 0 for transporting dangerous goods	Display and control panel	Optionally: Manoeuvre assistance button or Trailer Remote Control

### Recommendations for air supply

Reservoir sizes	Application
80 litre	One lifting axle
100 litre	Two lifting axles
120 litre	OptiLoad™ or OptiLoad™



## 4.10 Forced lowering of the lift axle

### Application

All trailer vehicles with lift axle

### Purpose

Switch off automatic axle lift to lower the raised lift axes.

### Function

The function can be activated with a button, a switch to ground or via the SmartBoard or the Trailer Remote Control. The lifting axle control is deactivated.

#### Activation with switch

The switch is closed: All axles are lowered.

The switch is opened: The automatic lifting axle control is activated.

#### Activation with button / Trailer Remote Control / SmartBoard

The button is pressed for longer than 5 seconds: All axles are lowered.



### Selecting the input level / parameter definition methods for forced lowering

The input levels (positive or ground) coming from the towing vehicle can be chosen in the TEBS E Diagnostic Software.

There are 2 ways to define parameters for the forced lowering function in the TEBS E Diagnostic Software:

- Forced lowering affects all lift axles or only the 2nd lift axle.
- Forced lowering is possible via button / Trailer Remote Control / SmartBoard or switch.

### Components

Components / Part number	Description	Connecting cable
<b>Button / switch</b>	Not part of WABCO's scope of supply  Activating / Deactivating the function	Universal cable 449 535 ... 0
<b>SmartBoard</b> 446 192 11. 0 	Alternative to switch/button  Activating / Deactivating the function	449 911 ... 0
<b>Trailer Remote Control</b> 446 122 080 0 	Alternative to switch/button  Only in combination with ELEX and TEBS E2 see chapter 5.1 "Electronic expansion module (ELEX)", page 89.  Activating / Deactivating the function	Connecting cable between Trailer Remote Control and fuse box in the HGV and a bracket are contained with the delivery.



## 4.11 Brake lining wear indication (BVA)

### Application

All trailer vehicles with disc brakes

### Purpose

Wear indicators, a wire integrated into the brake lining, monitor the wear of both linings of a disc brake.

### Function

Wear indicators can be connected on up to 6 brakes on the ECU. All wear indicators are connected in series and are connected to the wear input. The supply voltage is 24 V.

**1st warning level:** At 95 % brake pad wear. A short-circuit occurs.

**2nd warning level:** If the wear indicator indicates that the wire is worn through for the duration of at least 4 seconds (or longer), a voltage of 24 V will be measured at the lining wear sensor and the warning will be activated. The warning lamp will warn the driver if the end value for lining wear has been reached (100% brake pad wear).

In the case of Power On (ignition switched on) the warning lamp lights up in 4 cycles = 16 times.

The warning is interrupted when the vehicle's speed exceeds 7 km/h.

Replacing the wear indicators is automatically detected by the system when the linings are changed. Both warning levels are deactivated after 8 seconds.



The wear information is ascertained from the TCE in systems with TCE. It is the TEBS E that warns the driver or triggers the warning lamp. This is necessary because only an ECU can execute triggering the warning lamp in the event of service information having accumulated.

If a SmartBoard is installed, the warning will also be displayed on the SmartBoard.

### Saving the data for the lining change

The last five pad changes (including mileage and operating hours when the second warning level occurred) are stored in the ECU and can be read out via the TEBS E Diagnostic Software.

### Components

Components / Part number	Description	Connecting cable
<b>Wear indicator</b> 		449 816 ... 0
<b>SmartBoard</b> 446 192 11. 0 	Optional  Display for warnings	449 911 ... 0

## 4.12 Voltage supply from Telematics to GIO5

### Application

All trailer vehicles

### Purpose

Voltage supply from connected systems, e.g. Telematics to GIO5.

### Telematics

The Telematics unit can be connected to the SUBSYSTEMS slot or on GIO5 (only with Premium).

(WABCO recommendation: Connect Telematics to GIO5, so that the subsystems plug can be used e. g. for the SmartBoard or IVTM.

The TEBS E Diagnostic Software makes it possible to define a stand-by time for charging the telematics battery (telematics connection to GIO5) after switching the ignition off. In this case, the CAN bus is switched off – or the message is sent, indicating that the vehicle was switched off – and only the battery is charged. The time for charging corresponds with that for the ECAS standby operation.

## 4.13 Speed signal

### Application

All trailer vehicles

### Purpose

In addition to the speed switch ISS, which only outputs switch settings, TEBS E can provide a speed signal for evaluation by the connected systems, e.g. for controlling steering axles or for closing tank covers.

### Function

The TEBS E Modulator provides a speed signal in the form of a pulse-width modulated rectangular signal.

### Components

Components / Part number	Description
"Universal" cable 449 535 ... 0	4-pin, open  Cable colours: red = pin 1 (v signal) brown = pin 2 (ground) yellow/green = pin 3 blue = pin 4

## 4.14 Steady positive voltages 1 and 2

### Application

All trailer vehicles

### Purpose

Two steady power supplies are provided. The corresponding parameter settings can be used for output of a steady positive voltage (terminal 15) for the supply of,

for example, connected electronic systems or solenoid valves. The stand-by time corresponds with the stand-by time of the ECU.

### Function

Two 24 V outputs with a steady load of max. 1.5 A can be connected to the Trailer EBS E Modulator.

The output is monitored only when the TEBS E is switched on. Optionally, monitoring can be deactivated if, for example, components are connected via a switch.

### Components

Components / Part number	Description	Connecting cable
Switch	Not part of WABCO's scope of supply	Universal cable 449 535 ... 0

## 4.15 Road finisher brake

### Application

Tipper vehicle

### Purpose

The "road finisher brake" function is used for targeted braking of tipper bodies during operation with road finishers. In this case, the vehicle trailer is pushed by the road finisher while tipping.

#### TEBS E1

To prevent rolling back on a slope, TEBS E brakes the tipper independently and in accordance with the load.

### Function

Mechanical switches can be used for activation in operation (road finisher operation on/off) and an unloading level switch for the position of the tipper (pushbutton or proximity switch). When using ECAS valves, tipping of the tipper body can be detected via the unloading level switch (see chapter 4.3.2 "Driving level", page 57).

The unloading level switch can be activated or deactivated based on the customer's wishes. An optional switch can be provided for this or a parameter or a shut-off on the SmartBoard.

The control pressure defined in the TEBS E Diagnostic Software can be changed manually via the SmartBoard or Trailer Remote Control. The minimum control pressure in this case is 0.5 bar and the maximum control pressure is 6.5 bar. The value last set via the SmartBoard or Trailer Remote Control when switching the function off is valid again upon switching on again.

The automatic shut-off for this function occurs at speed  $v > 10$  km/h.

### Proximity switch

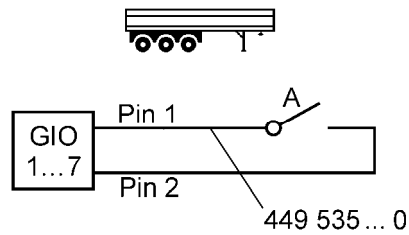
Proximity switches are used in technical processes for position detection of workpieces and as triggers for safety measures. The proximity switch works as a contact-free sensor or switch.

The following sensors have also been tested as proximity switches by WABCO:

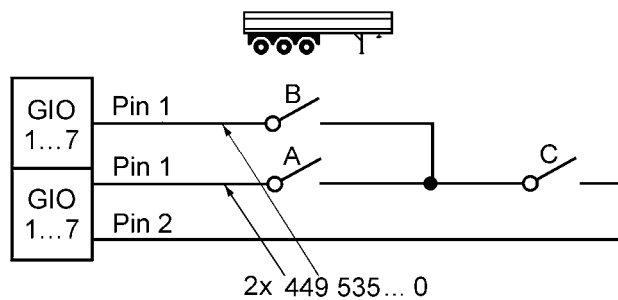
- Telemecanique XS7C1A1DAM8
- Schönbuch Electronic IO25CT 302408
- Balluff BES M30MF-USC15B-BP03

## Connection to GIO

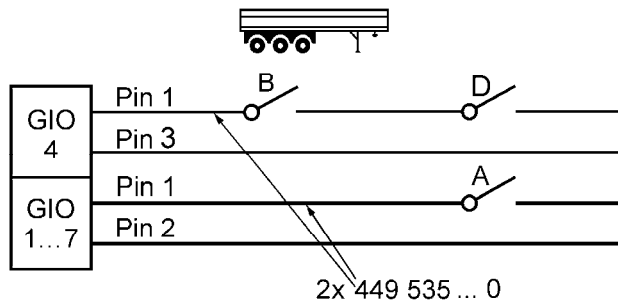
## Mechanical switch I for road finishers



## Mechanical switch II for road finishers



## Switching option with proximity switch for road finishers



## Legend

- |   |                                 |
|---|---------------------------------|
| <b>A</b> Switch<br>"Road finisher brake on/off" | <b>B</b> Unloading level switch |
| <b>C</b> Raise/lower dumper                     | <b>D</b> Proximity switch       |

## Parameter

Road finisher brake = Mechanical switch

Unloading level switch = Proximity switch

Parameters for switching off the unloading level can be defined in the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2 => Road finisher brake*.



**Keep in mind:** Shut off unloading level if no unloading level is desired for road finisher operation. Requirement: The proximity switch switches the unloading level. The unloading level switch is then dispensable.

A 2 pole proximity switch can be connected (Connection to GIO 4, pins 1 and 3, cable 449 535 ... 0).



This proximity switch can be used for functions "Unloading level" and "Road finisher brake". Every proximity switch has a different switching threshold concerning the distance away from the tipping body object to be detected.

If both functions are to be active, two additional switch inputs are required so that both functions can be switched on and off separately.

### Setting the pressure definition

The *pressure definition pm* for braking can be set in the TEBS E Diagnostic Software from 1 to 6.5 bar see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2 => Road finisher brake*. The controlled brake pressure depends on the load, i.e. in road finisher operation, the brake pressure is adapted (dynamic LSV).

### Components

Components / Part number	Description	Connecting cable
<b>Switch</b>	Not part of WABCO's scope of supply  Activating / Deactivating the function	<b>Universal cable</b> 449 535 ... 0
<b>SmartBoard</b> 446 192 11. 0 	Alternative to switch  Possibilities: <ul style="list-style-type: none"> <li>Activating / Deactivating the function</li> <li>Setting the pressure definition</li> </ul>	449 911 ... 0
<b>Trailer Remote Control</b> 446 122 080 0 	Alternative to switch  Only in combination with ELEX and TEBS E2 see chapter 5.1 "Electronic expansion module (ELEX)", page 89.  Possibilities: <ul style="list-style-type: none"> <li>Activating / Deactivating the function</li> <li>Setting the pressure definition</li> </ul>	Connecting cable between Trailer Remote Control and fuse box in the HGV and a bracket are contained with the delivery.

## 4.16 Trailer Extending Control

### Application

For example in the long adjustable semitrailer or drawbar trailer with 4S/3M system.

### Purpose

With this function, vehicles that can be adjusted in length can be extended and retracted much more comfortably for the driver and without the use of additional tools (such as e.g. chocks or other components installed in the trailer). The last multi-axle combination brakes and the trailer is pulled apart with the towing vehicle.

### Function

The function has different modes of operation depending on the type of vehicle:



#### Semitrailer

On semitrailers, the function can be selected in combination with parameter *without load-dependent brake pressure (LSV)* see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2*. If the function is activated with a switch or the SmartBoard, the multi-axle combination brakes with full brake pressure (without LSV characteristic curve) so that the trailer can be extended by slowly driving the towing vehicle.

#### Drawbar trailer

Here, the parameter *Brake rear aggregate only* can be selected see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2*. In this case, only the last axle (axle group) brakes so that the towing vehicle can extend the trailer by driving slowly.

### Components

Components / Part number	Description	Connecting cable
<b>Switch</b>	Not part of WABCO's scope of supply  Activating / Deactivating the function	Universal cable 449 535 ... 0
<b>SmartBoard</b> 446 192 11. 0 	Alternative to switch  Activating / Deactivating the function	449 911 ... 0
<b>Trailer Remote Control</b> 446 122 080 0 	Alternative to switch  Only in combination with ELEX and TEBS E2 see chapter 5.1 "Electronic expansion module (ELEX)", page 89.  Activating / Deactivating the function	Connecting cable between Trailer Remote Control and fuse box in the HGV and a bracket are contained with the delivery.

## 4.17 Relaxation function (Bounce Control)

### Application

All trailer vehicles

### Purpose



During loading and unloading procedures of semitrailers, the axle assembly is stressed if the brakes are applied on the entire unit. If the handbrake is released after the unloading process for example, the chassis can spring up suddenly because the air suspension lifts immediately with the still full air suspension bellows and the lack of a load on the vehicle. The relaxation function prevents this sudden jumping of the chassis and therefore protects the load.

### Function

The function can be activated by button, SmartBoard or Trailer Remote Control.

The tension on the applied brakes is released with the actuation of the brake cylinder from the modulator. The brakes are released by side (for semitrailer/central axle trailer) or by axle (for drawbar trailer) for this purpose. Braking the vehicle is always at over 18% because the brake cylinders are released one after the other.

## Components

Components / Part number	Description	Connecting cable
<b>Button</b>	Not part of WABCO's scope of supply  Activating / Deactivating the function	Universal cable 449 535 ... 0
<b>SmartBoard</b> 446 192 11. 0 	Alternative to button  Activating / Deactivating the function	449 911 ... 0
<b>Trailer Remote Control</b> 446 122 080 0 	Alternative to button  Only in combination with ELEX and TEBS E2 see chapter 5.1 "Electronic expansion module (ELEX)", page 89.  Activating / Deactivating the function	Connecting cable between Trailer Remote Control and fuse box in the HGV and a bracket are contained with the delivery.

## 4.18 Steering axle lock

**CAUTION** – Maintain the guidelines for safe operation of steering axes.  
The steering axle must be locked without power.



### Application

Semitrailer with steering axle

### Purpose

With TEBS a steering axle can be actuated, speed-dependent or with the detection of reverse travel by a cylinder and locked in straight travel position as well.

The steering axle can be locked depending on the speed to guarantee stable straight travel at high speeds. The steering axle can also be locked by monitoring the reversing lights when reversing.

### Function

The cylinder is actuated via a solenoid valve. The solenoid valve is actuated by the TEBS E modulator depending on the defined speed.

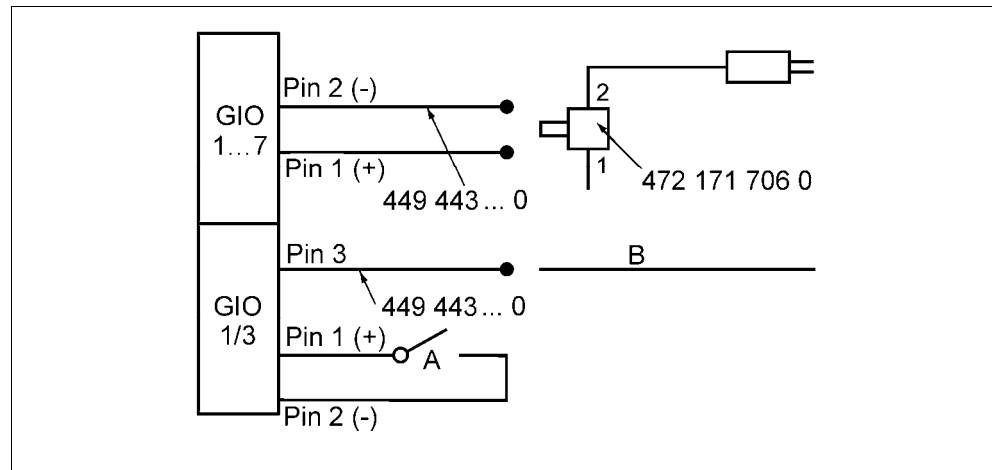
When travelling at normal speed (e.g. > 30 km/h), the steering axle is locked by the GIO function. If the defined speed is exceeded, the GIO function release the lock and the steering axle steers into the curve.

At a standstill ( $v < 1.8 \text{ km/h}$ ), the steering axle is locked again. This is maintained by applying the reverse gear (with active reverse lights), to prevent jack-knifing while reversing.

If the vehicle moves forward again, the lock is maintained up to a defined speed ( $> 1.8 \text{ km/h}$ ), then released and applied again upon exceeding a second defined speed.

With an additional parameter, you can also lock the steering axle with the lift axle raised.

### Circuit Diagram



#### Legend

**A** Optional switch for locking the steering axle      **B** (+) signal from the reversing lights

## 4.19 Tilt Alert

### Application

Trailer vehicles with tipper body

### Purpose

Monitoring the tilt angle of the vehicle.

### Function

In every TEBS E modulator, a lateral acceleration sensor is integrated for the RSS function. This lateral acceleration sensor simultaneously provides information on the inclination of the vehicle to the body reference plane. The inclination of the vehicle can be monitored by the TEBS E modulator.

If an inclination ( $0^\circ - 20^\circ$ ) of the frame, defined by the TEBS E Diagnostic Software, is exceeded, a warning can be sent to the driver by the ECU and shown by the SmartBoard or a horn/revolving light can be switched on.

The warning threshold must always be able to be seen depending on the specific vehicle and must be specified by the vehicle manufacturer.





The driver is to be instructed that e.g. tipping a body is to be stopped immediately if a warning message is received.

The function "Tilt warning" is only a supportive function and does not void the driver's responsibility for monitoring the vehicle.



## Components

Components / Part number	Description	Connecting cable
<b>Horn/Rotary beacon</b>	Not part of WABCO's scope of supply	
<b>SmartBoard</b> 446 192 11. 0 	Optional Display for warnings	449 911 ... 0
<b>Trailer Remote Control</b> 446 122 080 0 	Alternative to SmartBoard  Only in combination with ELEX and TEBS E2 see chapter 5.1 "Electronic expansion module (ELEX)", page 89.  Display for warnings	Connecting cable between Trailer Remote Control and fuse box in the HGV and a bracket are contained with the delivery.

## 4.20 Forklift control

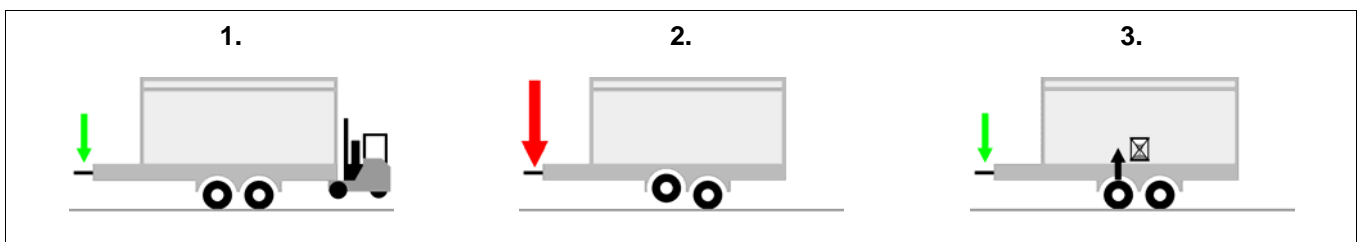
### Application

Mainly for central axle trailer with forklift.

### Purpose

Optimising the support load, if the forklift is missing as counterbalance.

### Function



Central axle trailers with attached forklift are normally constructed so that when the forklift is attached, the weight distribution is balanced between front and back. A respectively broadly spread support load works as a counterload to the additional weight of the forklift (Fig. 1).

If this type of central axle trailer is travelling under a partial load, but without the forklift and a raised lift axle, the excessive weight of the construction can lead to extra support load on the trailer coupling since the counterweight of the forklift is missing (Fig. 2).

With the function "Forklift control", raising the lift axle can be delayed with a partially loaded vehicle without forklift so that the support load is not too great on the coupling. The axle that remains on the ground causes the wheelbase to be short so that the complete support load is not on the coupling, because the back of the trailer, even without the forklift, is a more efficient counterbalance (Fig. 3).

**Function prerequisites**

Mechanical switch (pushbutton) or proximity switch for detecting the forklift.

The load on the trailer should be distributed evenly to prevent any additional influence of the support load.

**Parameter setting**

The Trailer EBS E uses a proximity switch or a mechanical switch to detect whether a forklift is docked on the vehicle and automatically switches between the two lift axle characteristic curves.

a) Characteristic curve for controlling the lift axle with attached forklift

b) Characteristic curve for controlling the lift axle with unattached forklift

Both characteristic curves are to be defined by the vehicle manufacturer based on the desired, load-dependent time for raising the lift axle see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 1* => *Lift axle control with forklift detection*.

Components / Part number	Description	Cable
<b>Switch</b>	Not part of WABCO's scope of supply Activating / Deactivating the function	Universal cable 449 535 ... 0

**4.21 Brake release function****Application**

Car transports for example

**Purpose**

Release the service brake of the trailer at a standstill.

**Function**

The function is activated with an external button or via the SmartBoard.

When actuating the brake release function and a simultaneous actuation of the hydraulic tension strut (by hydraulic cylinder), the trailer brake is released and the length of the trailer can be changed with hydraulics for instance.

When releasing the button or the respective button of the SmartBoard, the brake is immediately filled with air again braking the trailer vehicle.


**Requirements for the brake release functions**

- The parking brake in the towing vehicle is actuated.
- The pressure on the yellow coupling head must be greater than 6.5 bar. The brake release function will be aborted when the pressure on the yellow coupling head drops.
- The vehicle must not roll. The brake release function will be aborted at a speed  $v > 1.8 \text{ km/h}$ .



For this function, the certificate "Brake release and relaxation function – EB 158.0" applies see chapter 3.3 "Certification and standards", page 21.

## Components

Components / Part number	Description	Connecting cable
<b>Button</b>	Not part of WABCO's scope of supply Activating / Deactivating the function	
<b>SmartBoard</b> 446 192 11. 0 	Alternative to button Activating / Deactivating the function	449 911 ... 0

## 4.22 Additional brake light (Emergency Brake Alert)

### Application

All trailer vehicles

### Purpose

If the vehicle is in a hazardous situation and must brake abruptly, a third brake light can be actuated. This brake light can either be illuminated permanently or flash with an adjustable frequency while braking.

The function is automatically activated by the TEBS E modulator depending on the following situations:

- If the vehicle deceleration is greater than 0.4 g in a panic braking procedure.
- If an ABS control occurs at a speed of > 50 km/h.

The function is ended again if the vehicle deceleration is under the value 0.25 g or the ABS control is deactivated again.

### Components

Components / Part number	Description	Connecting cable
<b>Additional brake light</b>	LED or bulb Not part of WABCO's scope of supply	449 535 ... 0
<b>Relay</b>	Not part of WABCO's scope of supply	449 535 ... 0

### Installation

GIO diagram 841 802 291 0 see chapter 10.5 "GIO diagrams", page 181.

- Connect an additional third brake light using a cable with open end (e.g. 449 535 ... 0) to a free GIO slot.

This additional brake light is only activated during the panic braking procedure.

### Actuation of the existing brake lights

As an alternative, an additional relay can be used to flash the existing brake light in emergency situations.

In some towing vehicles, the function for the trailer brake lighting is monitored so that a basic load exists in relay operation in both switching states (brake light or resistance), so that no error is detected from the towing vehicle.

The GIO output is allowed to be loaded to maximum 1.5 A.

### Setting the actuation method / flashing frequency

- Under *Emergency brake light output*, select the actuation method *Actuation permanent* or *Actuation periodic* in the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 3*.
- Set the flashing frequency if necessary (between 1 Hz and 10 Hz). (WABCO recommendation: 3 Hz).
- If LEDs are installed as brake lights, activate the parameter *LED installed*.

## 4.23 Immobilizer

### Application

All trailer vehicles

### Purpose

Immobilizer for reducing the risk of theft

The function can also be used as an "electric parking brake". The parked vehicle is secured against rolling in case unauthorised persons actuate the red button on the PREV either accidentally or on purpose.

### Function

Using an integrated pulse-controlled lift axle valve, the wheels of a parked vehicle can be blocked via the Tristop® cylinder.

The immobilizer can be activated or deactivated by entering a self-defined PIN key via the SmartBoard or the Trailer Remote Control.

If a vehicle is moved with the immobilizer activated or the system is manipulated, the TEBS E modulator can output an alarm signal (24 V voltage) to a connected optional output device (warning lamp, horn).

#### Emergency release function or emergency release

The emergency release function can be used to deactivate the immobilizer without entering the user PIN to allow moving the vehicle e.g. in critical situations.

- Define parameters for an emergency release function optionally in the window *TEBS - GIO parameter 2* see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125.

The emergency release function is activated via the SmartBoard and releases the vehicle for a defined period of time.

#### Example of situation process "Vehicle secured with immobilizer":

Trailer with towing vehicle must be moved from a critical road situation. PIN is not available.

- Activate the emergency release function via the SmartBoard or the Trailer Remote Control.
- Move the vehicle to a safe location.

As soon as a time of 30 seconds passes at a standstill, the immobilizer is activated again.

If necessary, this process can be repeated up to 3 times. The emergency release function is then made inaccessible.

After enabling the immobilizer with PIN and PUK, the emergency release function is available again.

**TEBS E2****Status display**

As of TEBS E2, the driver is notified of the immobilizer status with the yellow warning lamp. If the immobilizer is inactive, the warning lamp flashes eight times after switching the ignition on.

**Logging the events**

For logging and evaluating the events, certain activities with the immobilizer are stored with an entry in the operating data recorder (ODR) see chapter 3.10.6 "Operating data recorder (ODR)", page 44. This data can be viewed by insurance agencies or fleet managers for example.

An ODR event is displayed with the following events:




- Immobilizer status changes
- Incorrect PIN entered
- Moving of vehicle despite Immobilizer
- Emergency release function operated


**Power supply**

To activate/deactivate the immobilizer, the trailer must provide the power supply. This can be assured two different ways.

- Switch on ignition (Supply via Terminal 15)
- ECU StandBy time (Supply via terminal 30): In this case, a time parameter must be defined in the parameter settings see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - ABS/RSS => ECU standby time*.

**Components**

Components / Part number	Description	Connecting cable
<b>TEBS E Premium Modulator</b> 480 102 06. 0 		
<b>Lifting axle valve</b> LACV-IC 463 084 100 0 	Pulse-controlled	449 445 ... 0
<b>SmartBoard</b> 446 192 11. 0 	The operating capabilities are described under section "Operation".	449 911 ... 0

Components / Part number	Description	Connecting cable
<b>Trailer Remote Control</b> 446 122 080 0 	Alternative to SmartBoard  Only in combination with ELEX and TEBS E2 see chapter 5.1 "Electronic expansion module (ELEX)", page 89.  The operating capabilities are described under section "Operation".	Connecting cable between Trailer Remote Control and fuse box in the HGV and a bracket are contained with the delivery.
<b>Warning lamp / warning horn</b>	Optional  Not part of WABCO's scope of supply	
<b>PUK Access Code</b> 813 000 049 3	For starting up the Immobilizer	

**TEBS E1.5**

In TEBS E1.5 modulator, the immobilizer function cannot be combined with the ECAS valve 472 905 114 0 for electronic air suspension and controlling the function OptiTurn™ or OptiLoad™. The optional output devices can be connected to the GIO1-7. The output supply voltage is 24 V. With the EOL test of with menu *Actuation* (see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS-E Diagnostic Software*), the functionality of the immobilizer valve can be tested. Activating the function with the PUK key is not required in this case.

**TEBS E2**

As of modulator status TEBS E2, additional GIO interfaces of the immobilizer together with the functions OptiLoad™ and OptiTurn™ make it possible to install the optimal equipment:  
Lift axle valve (LACV-IC) 463 084 100 0 with an ECAS solenoid valve 472 905 114 0 or 2x lift axle valve (LACV-IC) 463 084 100 0 with the ECAS solenoid valve 472 880 030 0.

**Installation**

Information on installing see chapter 6.7 "Installation components for immobilizer", page 113.

**Parameter setting**

Information on parameter definition see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS - GIO parameter 2* => *Immobilizer*.

**Releasing and activating the immobilizer**

The serial number of the TEBS E modulator and the PUK are required after parameter definition for the initial release.

**PUK**

One PUK is necessary per release process/vehicle. This requires the document "PUK Access Code 813 000 049 3" with an individual voucher code (1x per vehicle).



With this voucher code, you can apply for the PUK:

<http://www.wabco-auto.com/> => Products => Brake & Stability Control => Electronic Braking System (EBS) => Trailer Immobilizer.

#### Task of the PUK

- Releasing the immobilizer function in the TEBS E modulator.
- Defining / changing the user PIN
- Definition of a new PIN after incorrect entry.

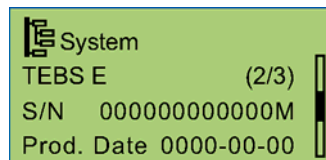


The PUK is reserved only for the vehicle owner. Handle the PUK with care and protect it from access to third-parties. Store the PUK in a safe location. WABCO will not be held responsible for the loss or misuse of the PUK.

#### Serial number of the TEBS E modulator

The 13 digit serial number (S/N) including the check number (last position) can be displayed as follows:

- SmartBoard (Menu *Tools/System Info/System*)
- EOL log



- System label see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS-E Diagnostic Software* => *Diagnostics/Printing/Print system label*

#### Release via the SmartBoard and definition/change of PIN

- Connect the SmartBoard with the TEBS E Modulator.
- Open menu *Tools/Settings/New PIN/with PUK* in the SmartBoard
- Enter the PUK into the SmartBoard.
- Define a PIN and enter it into the SmartBoard.
- Re-enter PIN to confirm.
  - ➔ Upon successful release, a confirmation appears on the display.

#### Enabling via the TEBS E Diagnostic Software

- Connect the TEBS E modulator with the TEBS E Diagnostic Software.
- Open the TEBS E Diagnostic Software see chapter 7.1 "Parameter definition with TEBS E Diagnostic Software", page 125 => Window *TEBS E Diagnostic Software*. Click on *Tools/Immobilizer*.
- Click on *PIN with Change super PIN*.
- Enter PUK into the field *Super PIN*.
- Define a PIN and enter it in the field *New PIN*.
- Confirm the PIN by re-entering it in the field *Re-enter new PIN*.
  - ➔ A confirmation window appears when the release is successful.

### Operational capabilities with the SmartBoard / Trailer Remote Control

Information on operation see chapter 8.6 "Operating the immobilizers", page 154.

Operating options	SmartBoard	Trailer Remote Control
Deactivation/activation with PIN entry	✓	✓
Deactivation/activation with stored PIN		✓ Must be released via parameter settings
Status information	✓	✓
Driver warning	✓ With ISO 7638 / Pin 5	✓ LED signal and acoustic warning, identical with status information
Emergency release function/emergency unlock	✓	✓
Change of PIN	✓	
Reactivation with PUK	✓	
Activation with PUK	✓	

## 4.24 Freely configurable functions

### Freely configurable digital function

#### Purpose

Free programming of a GIO digital input or output depending on the speeds and times by the vehicle manufacturer.

### Freely configurable analogue function

#### Purpose

Free programming of a GIO analogue input or output depending on the speeds and times by the vehicle manufacturer.

A switch signal and the vehicle speed may, for example, trigger an event to be saved or activation of a GIO output see chapter 3.10.6 "Operating data recorder (ODR)", page 44.

### Expansions

Utilisation of internal variables (e.g. from CAN bus) as input variables and connecting functions with one another. This also applies for analogue signals that exist on the telematics bus.

The SmartBoard can be used for actuating a live bottom discharge as well this way for example.

### Parameter setting

The type of switch in the SmartBoard (button, switch or deadman switch) is selected in the TEBS E Diagnostic Software.



Defining the freely configurable functions can be discussed with your WABCO contact. You can only load files that are created by WABCO into the ECU.